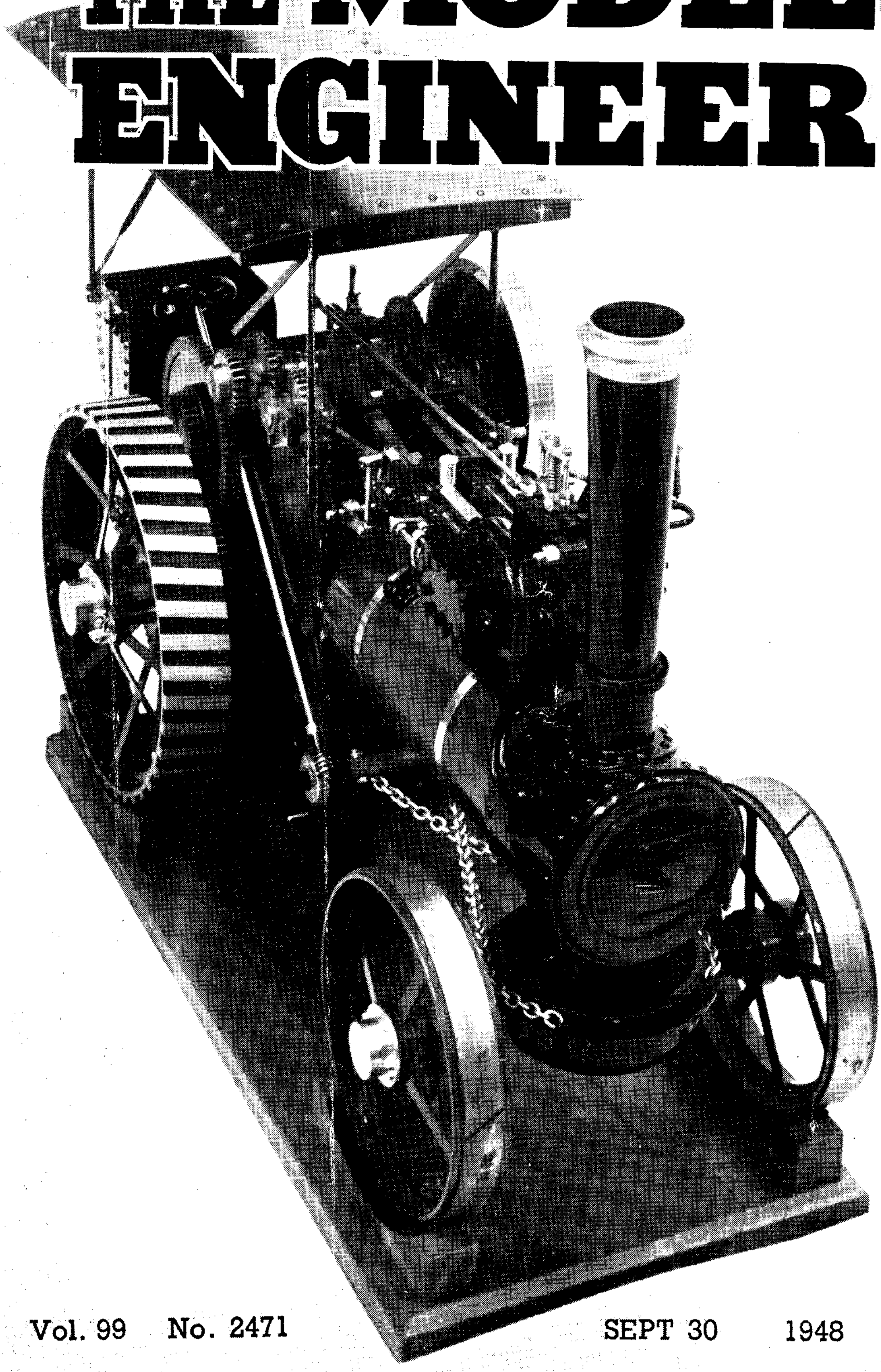
THE MODEL ENGINEER



Vol. 99 No. 2471 SEPT 30 1948 9d.

The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

30TH SEPTEMBER 1948 — VOL. 99. NO. 2471

SMOKE RINGS

Our Cover Picture

● THE TRACTION engine illustrated was built by Mr. F. L. Hall, of Twickenham; it is to $1\frac{1}{4}$-in. scale and is generally of such excellent construction and workmanship that it gained an H.C. Diploma. Yet the details of the basic design—for which, by the way, Mr. Hall was not responsible—seem to be somewhat dubious. For example, I cannot recall ever seeing a full-size traction engine with connecting-rods of rectangular section, and I would be interested if any readers could let me know of any.—J.N.M.

Counting the Cost

● FORTY-ONE years ago, when the late Mr. Percival Marshall staged the first MODEL ENGINEER Exhibition, the idea in his mind was that it should serve as an advertisement for the journal he loved so well and at the same time popularise the model engineering hobby. These are the two functions it has continued to fulfil ever since.

At one time, when the financial budget indicated that a substantial loss would be the probable result, representatives of the model trade, as well as vendors of rubber stamps and fountain pens were allowed to hire stands as the only alternative. Even in those early days, when the circulation of THE MODEL ENGINEER was only a fraction of what it is today, the exhibition was not run as a profit-making venture. It is the same today, though as the exhibition has grown, so have the costs.

To stage an exhibition of this magnitude in London is a far cry from the exhibitions by clubs in the provinces, where the halls are loaned or rented at a nominal cost, everyone gives his time and services free of charge, stands are improvised and the models are collected from members and clubs in the vicinity.

Such is the growth of the "M.E." Exhibition, that a full-time staff is employed, and plans for next year's exhibition were actually under way before the opening of this year's show. Rental of the hall, contractors to erect the stands, architects' fees, publicity experts, posters and advertising, salaried staff, insurance, artists, shipping agents, carriage, lighting and hundreds of items too numerous to mention go to swell the cost. But the "M.E." Exhibition is not a thing to be judged by balance sheets and dividends, it has now become a national, if not an international function, giving enjoyment to many thousands, promoting lasting friendships, stimulating craftsmanship, encouraging business and adding to our export trade.—P.D.

At Long Last

● TUESDAY, SEPTEMBER 14TH, 1948, was a notable day for me. I do not think that my admiration for that genius among locomotive engineers, the late George Jackson Churchward, is any secret to those readers who know me personally! I had the privilege of meeting him on two never-to-be-forgotten occasions, and all his works have had a peculiar fascination for me.

But I am digressing! On the date mentioned I had my first sight of the very latest "Castle" class engine at Paddington station. She is No. 7017, and is painted in the old G.W.R. style which, at the time mentioned, was bright and very new. But I was quite thrilled to notice that her nameplate read *G. J. Churchward.* Simple and straightforward, just as the great man himself would have preferred it to be, it was long overdue. But now that name is almost certain to be frequently seen by *ex*-G.W.R. staff and passengers on the Western Region lines for years to come. The engine is stationed at Old Oak Common, London.—J.N.M.

The International Section

● I WOULD like to take this opportunity to thank all our friends in Austria, Canada, Denmark, France, Holland, Norway, Spain, Sweden and Switzerland, whose courage in sending to our exhibition the treasured fruits of their labours, made possible a display unique in the history of model engineering.

Already in THE MODEL ENGINEER, on page 236, we have published a picture of one of the beautifully executed Swedish ship models, and our cover picture for September 9th gives an idea of the high quality of some of the engineering exhibits featured on the International Stand.

It is as yet too early to forecast how this new feature of the "M.E." Exhibition will develop, but I for one could have spent hours at this stand alone, enjoying the insight which these models give into the customs, engineering technique and industrial development of these countries revealed by their historical models.
—P.D.

Models on the International stand at the "M.E." Exhibition

George Stephenson's Cottage

● I AM very glad to hear from Mr. T. S. Nicol, Secretary of the North East Coast Institution of Engineers and Shipbuilders, that George Stephenson's cottage at Wylam is to become the property of the National Trust; it will be permanently preserved as a national memorial.

In April last, Mr. H. B. Robin Powell, President of the Institution, issued an appeal for funds to enable the cottage to be purchased. The sum originally aimed at was £1,200, but, in view of the necessity of adequate funds to cover maintenance of the property, the "target" has been increased to £1,500; further donations are accordingly invited from individuals and firms. They should be forwarded to Mr. Nicol at Bolbec Hall, Newcastle-upon-Tyne.

Whether the cottage will continue to be inhabited or given over entirely to the housing of Stephenson relics is a question that must be left until the present housing difficulties are overcome; but I am sure that all lovers of railways and locomotives will feel relieved that one of the most historic buildings associated with the engineering profession is saved from possible demolition.—J.N.M.

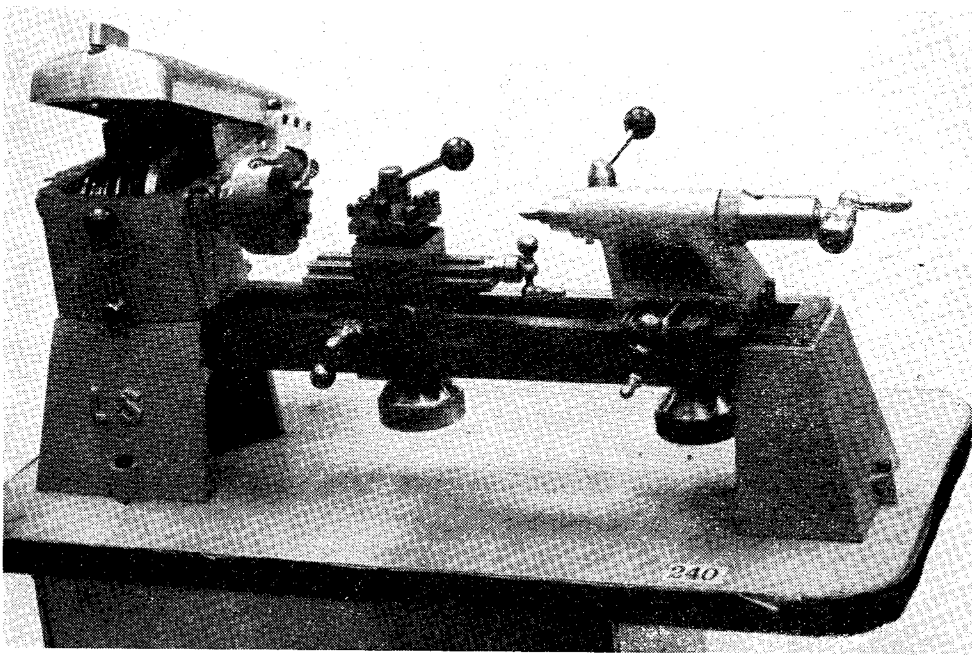
"Duplex" Visits the Exhibition

AS our chief interest is in the machines and small tools composing the main equipment of the general-purpose small workshop, we propose to deal only with this side of THE MODEL ENGINEER Exhibition, in spite of its comprehensive character.

Although, on the whole, the exhibits, particularly those in the competition sections, appeared to us to reach a high standard, we must confess to experiencing a feeling of disappointment when examining some of the less well-known machine tools shown by makers who have yet to establish a reputation for high-class work.

While we are fully aware of the difficulties arising from controls, lack of skilled labour, and mounting costs with which manufacturers have to contend, we feel, nevertheless, that the maintenance of good standards of design, workmanship, and finish are of paramount importance in the best interests of the manufacturer and user alike, and any lowering of these standards is a short-sighted policy which must eventually cause harm, not only to that section of the industry immediately concerned, but also to our engineering reputation in a wider field.

Poor finish of either working or structural parts may be easily seen, but the detection of inaccuracies of workmanship may require a careful instrumental examination such as is not usually practicable at the time of purchase.



The 2-in. centre lathe by Mr. L. Shepherd, fitted with tailstock mounted on a cross-slide, and an ingenious belt-tensioning device

As a rule, it is unlikely that high-class workmanship will lie concealed beneath a poorly finished exterior, and a conscientious manufacturer will not expend valuable time in producing a high external finish at the expense of accurate workmanship in the more important working parts.

Now, there are commonly-accepted standards of workmanship essential for ensuring an accurate performance in machine tools, such as those demanded in machines for acceptance by government departments, and, more precisely, the Schlesinger scale of accuracy recognised in industry both in this country and abroad.

These requirements are by no means exacting and are, we find, commonly, although unwittingly, complied with in the small machine tools, such as drilling machines, built by amateurs even when using limited workshop equipment.

We would, therefore, make bold to suggest to those who cater for the amateur and other users of small workshops that they should adopt some such standard and proclaim it, in order that a buyer in any part of the world may know the quality and performance to be expected of his purchase. Those who do not require an accurate or durable machine can then buy in the cheapest market, and those who do want good quality will not be disappointed.

Again, the experienced amateur commonly

avails himself of the most accurate known method of fitting machine spindles and their bearings, namely, by lapping them, probably with home-made laps.

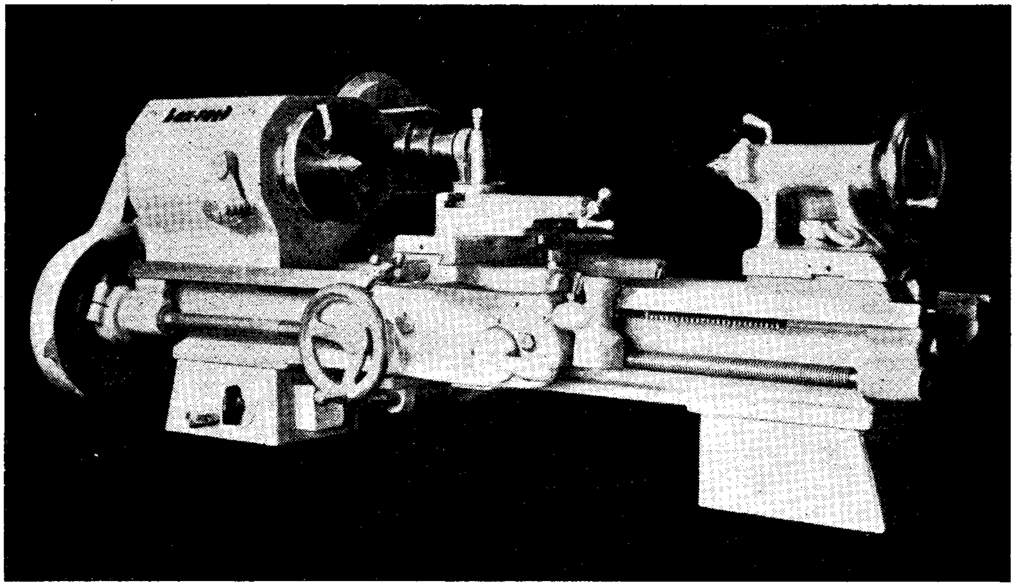
Now that efficient and quick-acting lapping equipment is produced commercially, it does not seem unreasonable to expect that the essential working parts of small manufactured machines should receive a lapped finish to remove even the slight inaccuracies remaining after the finish-grinding process.

Further, it does not seemingly, always meet the case to finish these machine parts by grinding, nor does it necessarily convey to the purchaser an assurance that the parts have been accurately fitted ; to state a case in point, we recently examined a new small drilling machine where in the descriptive literature it was pointed out that the spindle was ground ; it certainly was, but the resulting surface was rough to the touch and capable of cutting the bearings ; moreover, this spindle, as fitted, had considerable side-shake in its bearings.

On the S.M.E.E. workshop display stand, however, we found a drilling machine and a small lathe which had been privately made ; both these tools were very well finished and the bearings and slides were, as far as we could judge, fitted to a high degree of accuracy ; in addition, we were informed by the maker that the usual instrumental tests had been applied and these showed that the accuracy of construction was fully in keeping with the general high quality of the machines.

We are not for a moment trying to tell small manufacturers their business, and they have our sympathy in the present difficult situation, but we are stating what is wanted and expected here and, as far as we know, abroad. The problem is, may be, an economic one, and if so, its solution is a matter for the experts in this particular field.

Not so many years ago, the expression " made in Germany " signified something badly made of poor materials, whereas the phrase " made in England of Sheffield steel " meant to the world at large the very best in fit, finish, and materials ; the products of Zeiss, Bosch and Boley came to give the lie to the former contention, and nothing will, we hope arise to jeopardise the latter.



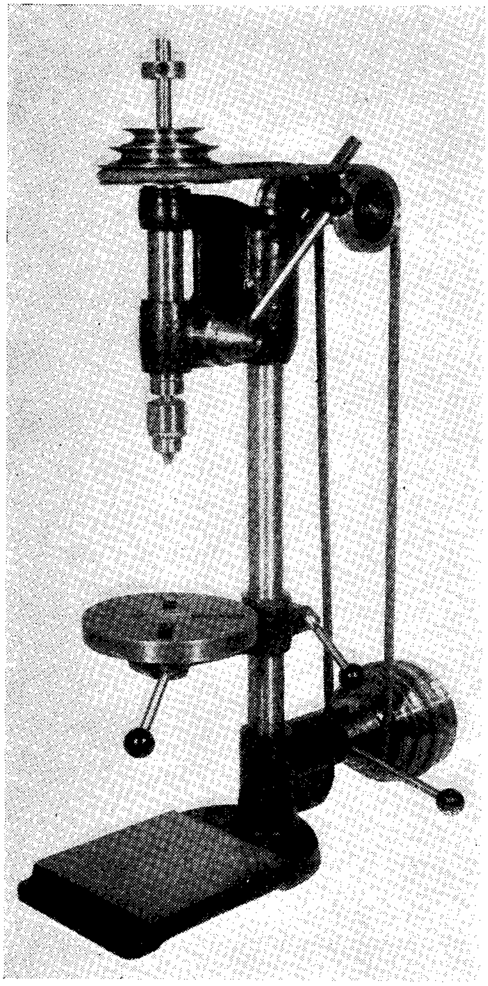
The Box-ford $4\frac{1}{2}$-in. centre lathe

Lathes

As might be expected, the popular Myford lathes were prominently displayed, and their merits are too well known to need any comment from us. In addition to these models, Messrs. Myford have recently introduced the excellent wood-working lathe, the ML 8, shown on Messrs. Buck & Ryan's stand.

This lathe is of sturdy design for a machine of its class and is really well finished. In order to reduce the driving power required for the high speeds necessary in wood turning, the mandrel runs on large ball-bearings of special design, and the driving motor is well protected from chips by being fixed below the top of the special bench on which the machine stands.

An ingenious form of control for the drive unit ensures easy and rapid changing and tensioning. The tailstock and tool rest are located by means of tenons sliding in the longitudinal slot formed in the upper surface of the round bed, and each of these units is quickly secured in place by the action of a ball-ended clamping lever. We noticed also that the front face of the driving-pulley flange was drilled with a series of holes to afford a ready means of indexing the work.



The ⅜-in. drilling machine shown by Messrs. Buck & Ryan

For turning work of large diameter, attachments can be secured to the tail of the mandrel, and in this case the specially designed rest fitted to the lathe bench is used to support the turning tool.

A full range of attachments for use with the lathe is, we understand, being produced.

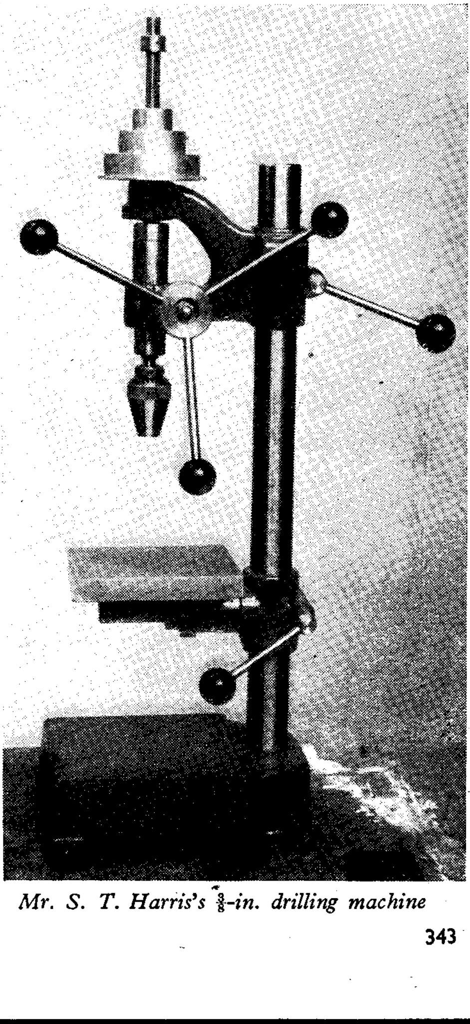
The Box-ford 4½ in. lathe attracted attention, as it appears to be not unlike the American South Bend lathe which has become popular in this country owing to its good design and high finish, as well as the extensive range of accessories provided by the makers. Likewise, it is to be produced in three types: Model A with a Norton quick-change gear box and fully automatic apron gear; Model B with similar apron gear but with a quadrant type of gear change; and Model C with a quadrant gear change and automatic sliding movement only.

The bed, which is of the inverted V type, is continuous and has no gap; this design is favoured by the makers and by many lathe users who find that working close to the headstock is thus greatly facilitated, particularly when draw-in mandrel collets are used.

Should an increase of centre height be needed on occasion, both the headstock and the tailstock can be raised by means of blocks specially made for the purpose. The large range of South Bend accessories, already mentioned, can, we understand, be used with the Box-ford lathe; these include: draw-in mandrel collets, a taper-turning attachment, a milling head, and many other useful devices.

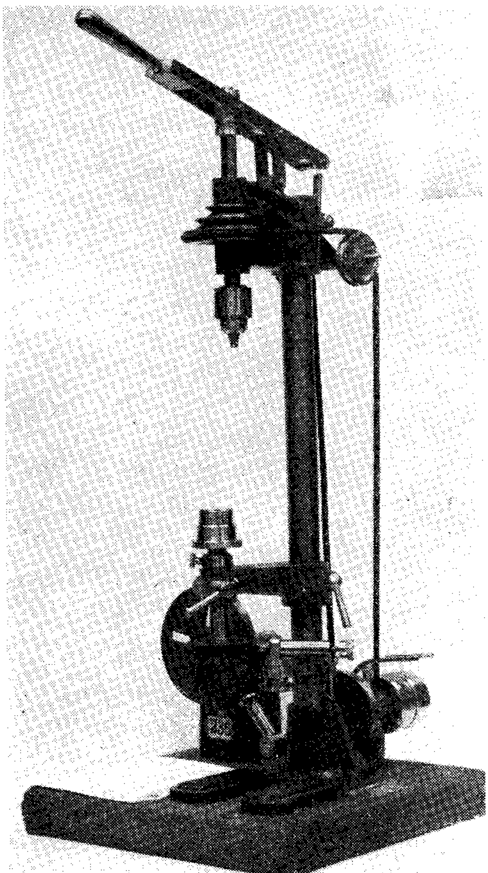
A boring table will, we hope, be included in the list of extra equipment, as this is almost indispensable to those who use their lathes for a wide variety of machining operations.

As previously mentioned, the small lathe shown on the S.M.E.E. workshop stand and made by Mr. S. T. Harris was beautifully finished and apparently very accurately constructed; it might well serve as an example to lathe makers in a larger field.



Mr. S. T. Harris's ⅜-in. drilling machine

We were not a little surprised to find amongst the competition entries a very well-made small lathe with a bronze bed ; we do not know the reason for the choice of this material in this situation—it may have been due to a difficulty in obtaining an iron casting—but the labour involved might, perhaps, have been expended to better advantage had a metal more resistant to shock and wear been used. In this section, too, we noticed a small lathe with its tailstock mounted on a cross-slide ; no doubt this was designed for some special purpose, but on the whole we prefer a rigid, centrally-fixed tailstock. The belt-tensioning device fitted to this machine is most ingenious, for, when the belt cover is raised, the tension of both belts of the self-contained driving unit is automatically relieved and, when the cover is closed, the belts are again tightened in accordance with the adjustment of the setting stop.



A " Model Engineer " drilling machine fitted with dividing device

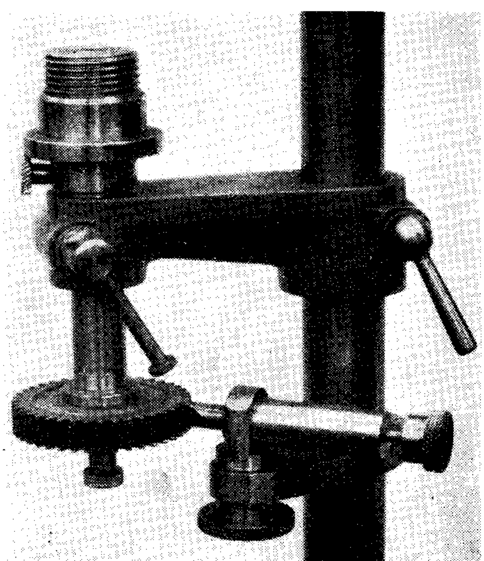
Drilling Machines

The $\frac{1}{4}$-in. capacity Champion drilling machine appears to maintain the popularity it has gained over a period of many years, and it was to be seen on several stands.

A newcomer in the field of rather larger machines was shown by Messrs. Buck & Ryan ; this machine has a drilling capacity of $\frac{5}{8}$ in. and is of good design and straightforward construction.

There is, we know, a demand for a machine of this type and capacity, but if it is to make its mark it is essential that its accuracy should be in accordance with the requirements of the small engineering workshop. While on the subject of drilling machines we might, perhaps, point out that, when a spring-box is fitted for returning the spindle to its raised position, sensitive drilling is made difficult if the spring loading markedly increases as the drill is fed downwards. To obviate this, a long, fine spring like a clock spring should be used which requires several turns to wind ; the tension, which should be adjustable, will then vary but little over the relatively short range of feed movement. As a further refinement, the provision of some form of feed scale will be found a great help when depth drilling.

The $\frac{3}{8}$-in. capacity drilling machine made by Mr. S. T. Harris and seen on the S.M.E.E. Workshop Stand is of outstandingly good design and workmanship ; moreover, the degree of accuracy attained is we were told, well up to the accepted standard for a high-class machine of this type.



The dividing mechanism fitted to the " Model Engineer " drilling machine

In the competition section some of the machine tools exhibited call for comment, which is made in no spirit of disparagement but rather with a view to offering some suggestions based on personal experience of the type of machines in question.

Aluminium alloys are, on the whole, less suitable than cast-iron for drilling-machine headstocks and table brackets ; and it is quite certain that the table of the machine, if it is to resist wear, must be made of harder material than aluminium.

Where comparatively soft metal such as aluminium is used for the headstock and guide pulleys, it is essential to bush these components with bronze in order to resist wear, although the latter material has the disadvantage that should the supply of lubricant fail, the bearings will quickly become scored and permanently damaged.

In the excellent original design of the "Model Engineer" drilling machine it may be remembered that the alloy-steel machine spindle ran directly in the cast-iron head casting ; it was also strongly recommended by the designer that the spindle and its bearings should be finely lapped to an accurate and close working fit.

A machine constructed in this manner by the writers has had several years of use without showing any sign of wear in its bearings. Cast-iron bearings fitted in this way develop a highly glazed, hard surface which is not only very resistant to wear but is also unaffected by a temporary cessation of the oil supply.

As mentioned above, a spring which imposes an increasingly heavy resistance on the feed, as the drilling spindle descends, interferes with the sensitive control of the feed lever : in this connection, the advantage gained, when an adjustable counter-weight is fitted instead of a spring, should not be overlooked.

We were impressed by the ingenious dividing device fitted to one of the "Model Engineer" type drilling machines exhibited. Here, an arbor which was formed as a replica of a lathe mandrel nose was fitted to the hole in the table bracket normally housing the spigot of the drilling table. At its lower end this arbor carried a changewheel which, with the aid of a spring detent, was used to index the work held in a chuck screwed on to the upper threaded portion of the arbor.

Shaping Machines

Messrs. Garners showed two small hand-operated shaping machines of simple but robust design and apparently capable of doing a variety of accurate work. The smaller machine, which had a 5-in. stroke and traverse, was demonstrated taking a fairly deep cut in mild-steel and leaving a good finish on the work. In this model there is no provision for setting over the tool slide, and angular machining is carried out by tilting the work table. The larger machine of 8-in. stroke is of rather more ambitious design, for it has an angularly adjustable ram head and an automatic feed for traversing carriage. Many model engineers would, we know, welcome a return of the Drummond hand-operated shaping machine, which from personal experience we found to be a very accurate tool of excellent and comprehensive design.

Small Tools

Messrs. Moore & Wright showed their customary display of fine tools, and amongst these we noticed a useful set of six small precision screwdrivers in a wooden case ; these have detachable and renewable collet-held blades which range in width from 0.025 in. to 0.1 in., and the tools have a dull chromium-plated finish The sets of small cold chisels made by this firm are not, perhaps, sufficiently well known to small workshop users. These tools are made of nickel alloy-steel, and although they are almost unbreakable and very keen-cutting, they can be readily sharpened with a file.

Many workers in the past have experienced difficulty in obtaining a satisfactory preparation for applying to the work preparatory to marking-out. For many years we have used for this purpose a quick-drying fluid called Talbot Blue. This liquid, we find, adheres most tenaciously to the surface of the work and maintains the visibility of the marking lines during drilling and shaping operations; but when required, it can be readily removed with a rag dipped in methylated spirit. For the convenience of users, this preparation is now put up in small tins and is obtainable from Messrs. Buck & Ryan.

Those Partly-constructed Models

AT the recent "M.E." Exhibition, I was not a little surprised to notice that, among the Competition entries, were some which were in a partly-constructed condition, and I feel that there must still exist some misunderstanding regarding the eligibility of such entries.

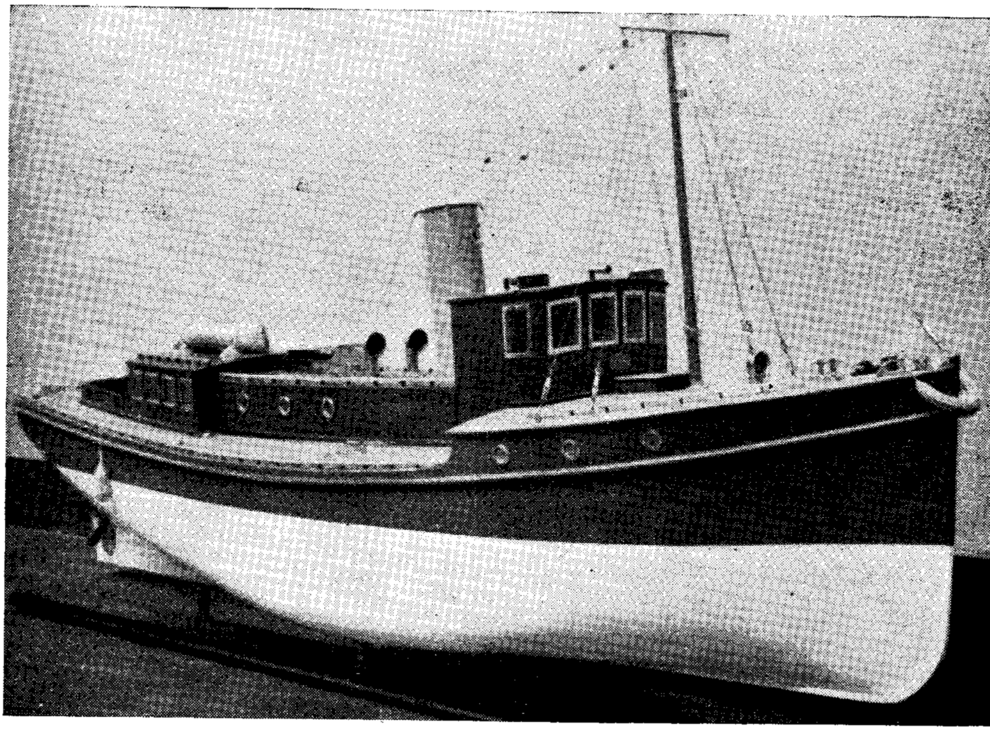
There is no reason, of course, why a competitor should not enter an unfinished piece of work if he has a particular reason for so doing ; but there are two important considerations which every competitor should bear in mind. First, once an unfinished model has been in the Competition, it cannot be entered again as a finished model in the future. Secondly, the judging of an unfinished exhibit is extremely difficult, if not impossible, because, whatever marks are awarded to it, the result can very seldom be strictly fair to the other competitors, or even to the exhibit itself.

An unfinished model can always be accepted as a Loan exhibit, even for two or three years in succession, if necessary, without barring its entering the Competition after it has been completed. I know that this has all been published before, but I feel that it cannot be too often explained.—J.N.M.

More About the Ship Models

by E. Bowness

IN the preliminary report on the ship models at the recent MODEL ENGINEER Exhibition which appeared in our issue of September 9th, we were only able to touch briefly on a few of the more outstanding models. We have now been through the many photographs we took during the exhibition and are able to publish a limited selection of them.



Dr. T. Fletcher's model river pilot boat

The first illustration shows the fine model of a river pilot boat by Dr. Fletcher of Colne, which won the Championship Cup in the Steamship section. Being a model of a small prototype, every external detail is included; the full rounded lines were reproduced very beautifully and the painting and finish were exceptionally good. The power plant, which was a two-cylinder petrol engine, though not quite the most appropriate engine for this type of craft, was nevertheless a nice clean piece of work and was fitted with a clutch and reversing gear.

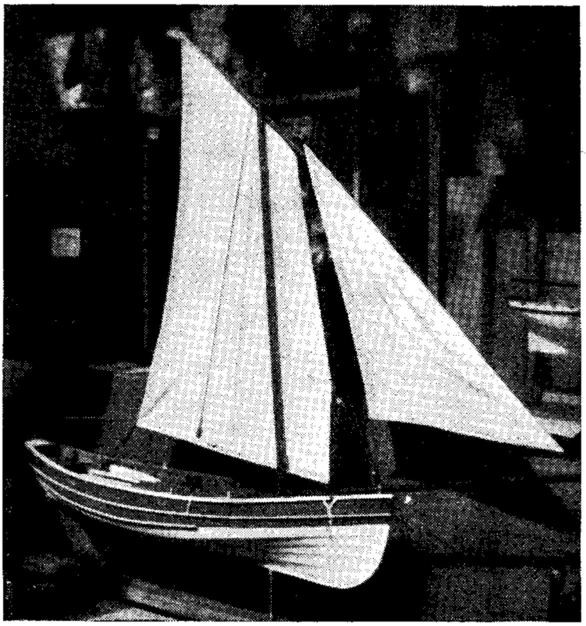
Atomic III, an experimental hydroplane by Mr. L. V. See of Portsmouth, attracted a great deal of attention. The fine, sleek lines of its beautifully constructed hull gave a tremendous impression of speed, while the layout and the workmanship of the power plant gave a corresponding impression of efficiency. An interesting feature of the hull was the introduction of adjustable planes, amidships and at the stern. These were hinged at their forward edges and were controlled by a cam and lever. They were designed so that when depressed, they assisted the boat to plane at speed. Another interesting feature was the hollow along the centre-line of the deck which gives a flow of cool air to the cylinder when the boat is in motion. We expect to hear more of this boat when the builder has made a few tests with it under power.

The air-sea rescue launch was a very popular prototype this year, and the model of the 67 ft. Thornycroft version by Mr. T. F. Hughes of West Wickham is a very fine example of the type. As will be seen from our illustration, the lines of the hull were faithfully reproduced, and the detail work and the finish were excellent. The deck fittings were quite up to the standard advocated by the builder's namesake, Mr. W. J. Hughes of Sheffield, in the series of articles on this subject which appeared in our pages some months ago.

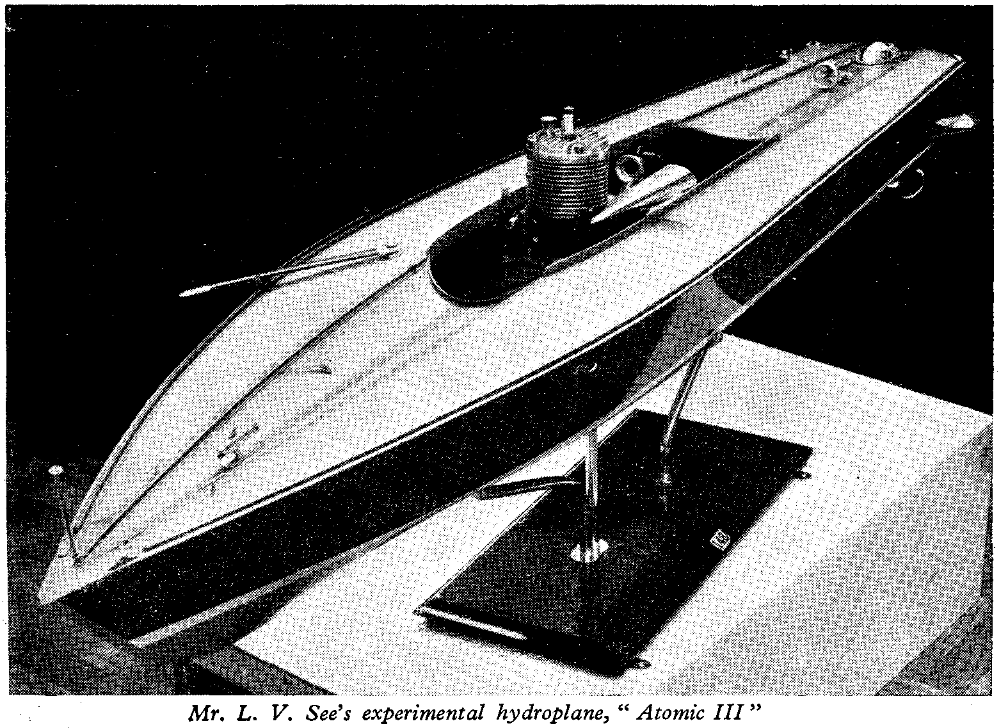
The 6 ft. model of H.M.S. *Vanguard* by Mr. G. H. Davis of Brighton, the well-known artist of *The Illustrated London News*, was an impressive piece of work. As it is a steam-driven working model, there is a certain robust character in the deck fittings and superstructure, while

the amount of detail shown reproduces very realistically the characteristics of the original. The whole of the centre portion of the superstructure can be lifted off to give access to the power plant which, if I remember rightly, was a Stuart Double Ten. Open grids were fitted very neatly at various points in the superstructure to provide ventilators for the power plant. The sea was turbulent and too light in colour for our ideas, but this is largely a matter for the builder himself to decide. We understand that radio control is to be fitted to this model in the near future.

There were a number of very interesting models of destroyers this year, the most notable being the exhibit by Mr. G. E. Fidler, of North Kensington. This was made to the articles and drawings published in THE MODEL ENGINEER during 1944. The hull was a fine example of plating in strakes on ribs in proper ship fashion; the superstructure was very neatly made and the amount of detail seemed just right for a working model. Another nice model was that of the des-



Mr D. C. Ray's fishing coble, " Eliza "



Mr. L. V. See's experimental hydroplane, " Atomic III "

A model Thornycroft A.S.R.L. by Mr. T. F. Hughes

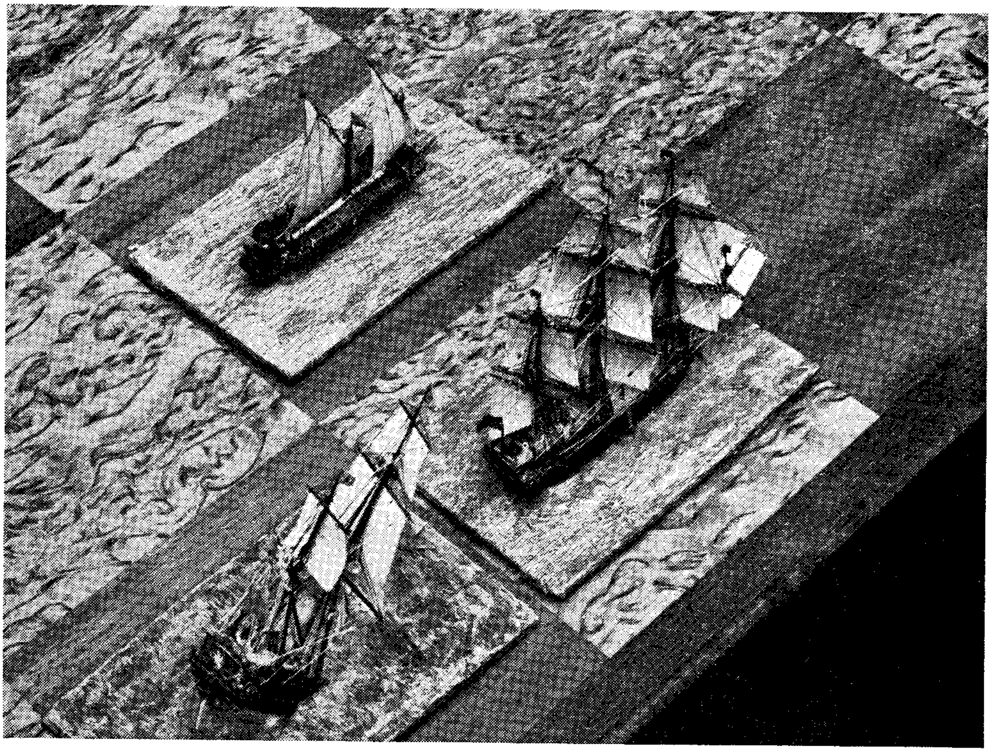
troyer *Icarus* by Mr. N. M. Peters of Wallington. This was smaller than the *Javelin* model, but the details of the superstructure and the finish of the job as a whole, were very commendable.

The cabin cruiser as a prototype came in for a certain amount of attention, one fine example being that of a Brooke motor cruiser by Mr. H. Brownless of Doncaster. This was a fully detailed replica of a typical cabin cruiser, and many of the visitors to the exhibition paused to admire the workmanship. The furnishings were carefully detailed and, as full access was provided to all parts of the hull, they could be inspected freely. Two of the entries were based on the articles by L. W. Sharpe describing the passenger liner *Penang* which appeared in our pages a year ago. Both these were very pleasing in appearance and the amount of detail in the superstructure was very satisfying. For anyone wishing to make a working model of moderate size, these articles are well worth studying.

There were a number of very interesting

exhibits in the miniature section. Mention has been made already of Mr. McNarry's model of *Queen Elizabeth,* Mrs. McNarry's miniature, which was a waterline model of a Cornish smugglers' lugger, was also a very nice piece of work. The hull was beautifully carved and with the brown sails, the neat rigging and the convincing sea, made a delightful picture. Mr. Taylor's model of the timber ship S.S. *Baltia* with its deck load and the typical list of this type of vessel, was much admired. Mr. Fitterer's scenic model of H.M.S. *King George V* and H.M.S. *Newcastle* in a heavy sea, was a fine piece of work and the representation of the spray flying across the bows as the ships met the seas was very convincing. Mr. Horsburgh's two entries, the Swedish ship *Saga* and the fruit ship *Joh Gorthon,* were particularly well done, the rigging being especially good. The rigging was of extremely fine material, whether of wire or human hair I cannot be certain, but it was quite taut and very neatly attached to the masts and hull. Mr. Anthes' model of S.S. *Silvia Onorato* ashore on the Goodwins was very realistic. This model was based on an aerial photograph of the wreck which appeared in the newspapers last winter. The broken water about the two portions of the ship which had been split in two halves, and the colour of the shallow water in the vicinity were perfect.

The photograph of Mr. D. C. Ray's Yorkshire coble *Eliza* which we reproduce herewith, gives some idea of the beautiful lines of the hull and the nice spacing of the planks. The workmanship and finish throughout this model were extremely good and it thoroughly deserved the bronze medal awarded. The rigging was carefully spliced and the cord used looked as if it had been made by hand.



A close-up of part of a chess-board, showing model ships for chessmen

Space prevents my enlarging on the sailing ship models. These included all types from the early Egyptian ship to the latest windjammer. There were a number of galleons of varying quality and two rather nice examples of the Elizabethan galleon from the Science Museum plans. Dr. M. M. Melrose's model of the *Bounty,* 1787, embodied some very nice work, especially in the rigging, and the same may be said of Mr. R. G. W. Cramp's *Victory* model. We have already made mention of Mr. Honey's model of Amundsen's jagt *Gjoa* which won the Championship Cup and of Dr. Rowland's *Brynhilda* which was the runner-up in this section.

Finally, we include a reproduction of a close-up of some of the chessmen in the Swedish entry, which was promised in our issue of September 9th. The ships shown include a ship of the line, a sinking ship, and a lateen rigged galley. The delicate workmanship will be noted even in the reproduction.

Boiler for the "Minx"

by "L.B.S.C."

As promised last week, here is the drawing of the boiler for the "Minx." A comparison with the boiler for "Maid of Kent" will show the similarity which I mentioned in the previous instalment. The barrel is same length and diameter, with the same smokebox tubeplate, longitudinal stays, and same arrangement of tubes and flues. The upper part of the firebox tubeplate, with the girder crown-stays, is also the same; the difference lies in the depth of the firebox, and its length, width, and shape at bottom. This firebox doesn't need to drop down between the hornblocks, but the foundation-ring can rest on them at the back end; consequently, we can "sneak" that little extra width, making the outer shell 4 in. wide, which allows $\frac{1}{16}$ in. clearance between the firebox wrapper and frame-plates at each side. Allowing for 3/32-in. or 13-gauge copper sheets for both firebox and wrapper, the width of the grate comes out at $2\frac{7}{8}$ in. and as it is $8\frac{1}{2}$ in. long, nobody need be under any misapprehension about how the boiler is going to steam. The slope of the grate gives plenty of depth below the tubes; but my boilers do not need a thick fire, which is why they steam freely with just a moderate draught. It doesn't need much effort to pull the necessary air through a thin fire.

The construction of the barrel and wrapper is exactly the same as described in last week's instalment. You can make it with a $12\frac{3}{4}$-in. length of 13-gauge copper tube 5 in. diameter, and a wrapper bent up from a piece of 13-gauge copper sheet measuring $19\frac{1}{4}$ in. by $9\frac{1}{2}$ in., joining the two by a "piston-ring" joint; or alternatively, cutting out a piece of 13-gauge sheet copper, $22\frac{1}{4}$ in. long and $19\frac{1}{4}$ in. wide, as shown in the reproduced drawing. One end is reduced to $16\frac{1}{2}$ in. width for a depth of $12\frac{3}{4}$ in., a cut $5\frac{1}{4}$ in. long is made in each side, and the remainder bevelled off as shown. The $16\frac{1}{2}$-in. section is rolled completely circular, and lapped over to form the 5-in. barrel; the rest forms the firebox wrapper. The whole doings is finished off and brazed up exactly as described for the "Maid." If anybody prefers the Belpaire firebox, make up a Belpaire shell as described last week, the upper part being to the dimensions then given, and the lower part to the same dimensions given here for the round-back. Personally, I rather favour the Belpaire boiler, as it not only gives more steam space, but is a little easier to stay; I find it an easier job to fit the crown-stay flanges to a flat wrapper instead of a curved one. An inexperienced coppersmith can make a good job of brazing the barrel to the Belpaire wrapper, whereas he might have trouble in filling up the vee-groove without any pinholes, on a two-piece round-back. Still, that difficulty doesn't arise with the one-piece barrel and wrapper bent up from sheet. Well, having got the "Minx" builders started on their boiler shell, we can now proceed to have a few words about the "internals" of both "Maid" and "Minx" boilers. The method of construction is exactly the same; only the dimensions differ, and not such a wonderful lot at that.

Firebox Construction

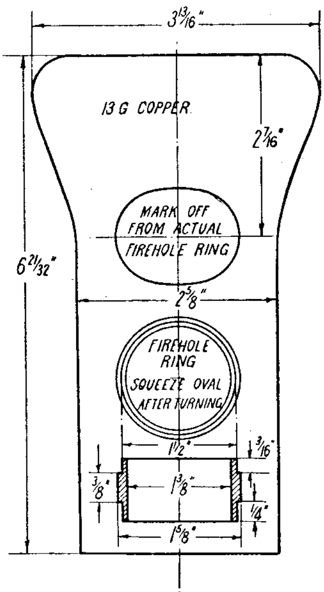
Both the firebox tubeplate and door-plate are knocked up over the same iron former, which is made as described for the one used for backhead and throatplate. Make it 3/32 in. less all round, except at bottom, then the dimension given for the door-plate shown in the illustration; this allows for the thickness of the formed flange, which brings it up to given size. I find it a good wheeze to set out the tube holes on the former, and drill them No. 40 or thereabouts, as the tubeplate can be "jig-drilled" before taking it off the former, and the latter is also used as a jig to locate the tube holes in the smokebox tubeplate. After cutting out the former, and trimming up with a file, round off one edge, to prevent too sharp an angle in the copper flanges. Then cut out your pieces of 3/32-in. copper sheet, same shape as former, but $\frac{5}{16}$ in. bigger all around except at bottom. Anneal by making them red-hot and plunging into cold water, then flange them over the former as previously described. Note: there is no need to make any plates too long; so "Minx" builders should cut their plates the right length from top to bottom before flanging, taking their measurements from the drawing of the boiler shown here. After flanging, trim off any raggedness with a file, also clean up the flanges themselves with the same file, ready for brazing. The more file-marks there are, the better the brazing material will hold.

While the firebox tubeplate is still on the former, after flanging is completed, run the drill through all the holes in the former, clean through the copper plate as well. After removing, open them out with a 27/64-in. drill. Ream the three bottom rows with a $\frac{7}{16}$-in. parallel reamer, and slightly countersink them on the side opposite to the flange. Open out the four in the top row with 47/64-in. drill, ream $\frac{3}{4}$ in. and countersink.

Before cutting the hole for the fire-hole ring, the ring itself must be made. This is of the Briggs type; and a piece of copper tube, $1\frac{5}{8}$ in. diameter, $\frac{3}{4}$ in. long, and 10-gauge or $\frac{1}{8}$ in. in the wall, will be needed. A casting in what is known as "plumbers' weldable metal" would also do. Chuck this in three-jaw, and turn down $\frac{3}{16}$ in. length to $1\frac{1}{2}$ in. diameter; reverse in chuck and repeat process, but turn away just enough to leave a full-size section $\frac{3}{8}$ in. long between the shoulders. Anneal the ring, and squeeze it oval in the bench vice, to bring the internal measurement to $1\frac{1}{8}$ in. by $1\frac{5}{8}$ in., or as near as you can get it. Lay this on the vertical centre-line of the door-plate, with the centre of the ring at position shown in drawings. Scratch a line all around it

with a scriber, then cut out the piece, either with a metal-piercing saw, or drilling holes all around, breaking out the piece and cleaning with a file. Clean up the turned parts of the ring, then put the shorter one through the hole, and beat down the part projecting inside, outwards and down into close contact with the door-plate, so that same is gripped between the bead and the shoulder.

The firebox sides and crown are made from one sheet of 13-gauge copper. The easiest way to get the exact length, is to run a bit of soft copper wire right around the flange, then straighten it out, measure it, and cut your copper sheet to the same dimensions. Bend the sheet to the shape of the firebox, same as described for the Belpaire wrapper, and clean the edges ; then rivet it to the flanges of the tubeplate and door-plate, in similar fashion to the Belpaire wrapper. You

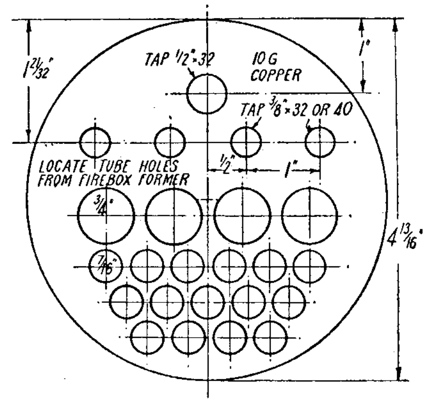


Door-plate (" Maid of Kent " length shown)

don't need a lot of rivets, just enough to hold the copper sheet in close contact with the flanges whilst brazing ; and you don't need to bother about fancy heads.

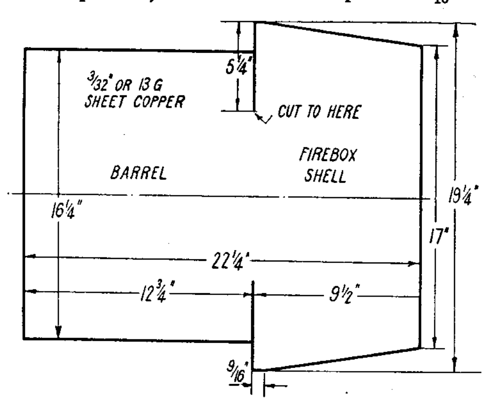
The crown-stays are of my pet girder pattern, as used on the smaller boilers I have described. Let those decry them who will ; the fact remains that the number of boilers I have personally built, ran into three figures long since, and I have never known a failure. During that time I have held several " post-mortems " on boilers with direct rod stays, and found same wasted away in the middle, to the thickness of a pin, which broke and let down the crown-sheet. There is a vast difference between using short rod stays between inner and outer firebox sides, and using long ones between firebox crown and wrapper sheet.

Bend the angles and channels from 3/32-in. or 13-gauge sheet copper, annealed before bending. The centre girder is formed from two angles, placed back-to-back, and riveted with 3/32-in. rivets at about ¾ in. centres. It is ¾ in. deep in the middle, and ½ in. at the ends, the bottom flanges being ½ in. wide, riveted to the firebox crown with same size rivets and spacing. The two side girders are made from one channel



Smokebox tubeplate (both boilers)

and one angle, riveted together as above, using two rows of rivets about ⅞ in. apart. On a round-back boiler, only one flange is needed at the top, as shown, if a fillet of spelter is run in when the brazing is in progress ; see further notes, when we come to that job. On a Belpaire, two channels are used, as shown in the illustration last week. At the point where the girders meet back-to-back, they should be 1¾ in. deep. Rivet them to the firebox crown with their inner faces 1 13/16 in. apart. The holes are drilled easily enough if you put a broken piece of No. 41 drill (I'll bet you have that requisite !) into the end of a piece of 3/16-in.



One-piece " Minx " boiler shell " in the flat " (trim bottom of wrapper to shape after bending)

round brass rod about 3 in. long, which allows the drill to be used almost vertically, without the chuck fouling the flange. Rest the firebox on a piece of bar held in the bench vice in an upright position ; let the rivet head inside the box rest on top of the bar, and flatten out the stem of the rivet above the flange, with a rivet

snap, or a bit of $\frac{3}{8}$-in. round steel rod with a countersink in the end. Just put it over the rivet stem and give it a few hearty clouts with a hammer. As I said before, pretty heads don't matter here; Inspector Meticulous would need "X-ray plus" eyes to investigate inside the boiler when it is finished and in steam!

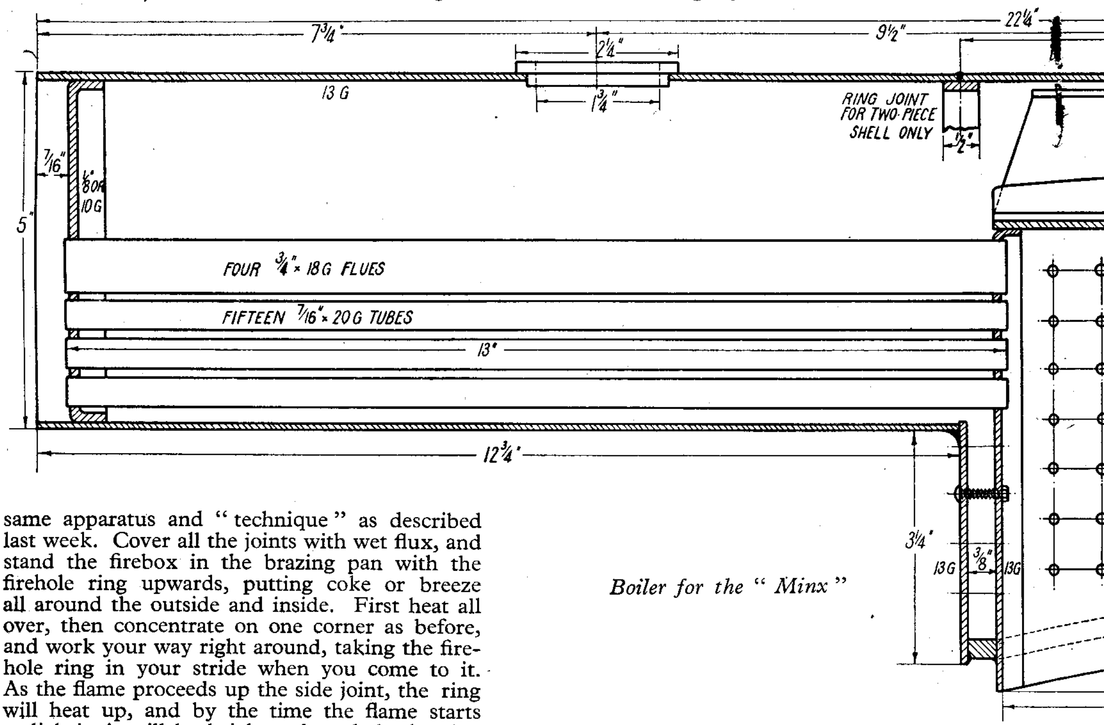
Second Brazing Operation

The firebox joints can now be brazed, using the same apparatus and "technique" as described last week. Cover all the joints with wet flux, and stand the firebox in the brazing pan with the firehole ring upwards, putting coke or breeze all around the outside and inside. First heat all over, then concentrate on one corner as before, and work your way right around, taking the fire-hole ring in your stride when you come to it. As the flame proceeds up the side joint, the ring will heat up, and by the time the flame starts to lick it, it will be bright red, and the brazing material can be applied to it when doing the adjacent seam. The part farthest away from the seam, will need a blow-up "all on its own"; run sufficient brazing material around the ring, to form a good fillet.

Next, turn the box over, and do the tubeplate all around; here, be careful not to play on the metal between the tube holes, or you'll suddenly find you have one big ragged hole instead of a lot of neat little round holes. Finally, stand the box the right way up, and do the crown-stay flanges. On this job, I recommend all amateur boiler-smiths, whether experienced or not, to run in a little coarse-grade silver-solder before applying the brazing strip; the reason being, that silver-solder has excellent penetrating powers, and will flow completely through the space between girder flange and firebox crown, preventing leakage around the rivets. Then apply the brazing strip, and run a fillet along the edge of each flange; you can, if you like, completely fill the little channels between the side and centre flanges. When you are quite certain there aren't any missed places, or "pinholes," let the job cool to black, then immerse in the pickle for 20 minutes or so, wash it off in running water, and clean up as before.

Tubes

Both boilers have four superheater flues of $\frac{3}{4}$-in. by 18-gauge copper tube, and fifteen $\frac{7}{16}$-in. by 20-gauge ordinary fire tubes. As a matter of fact, the flues could be 20-gauge and the tubes 22-gauge, ample for the working pressure of 80 lb., but the slightly thicker ones allow a little latitude for a beginner or inexperienced worker, as they are not so liable to become burnt when silver-soldering. Cut to a length of 13 in. There is no need to square the ends in the lathe, but I usually chuck the tubes one by one, and clean up the ends with a bit of rough emery-cloth, which helps the silver-solder to make a sound joint. The tubes should be a tight fit in the holes in the firebox tubeplate.



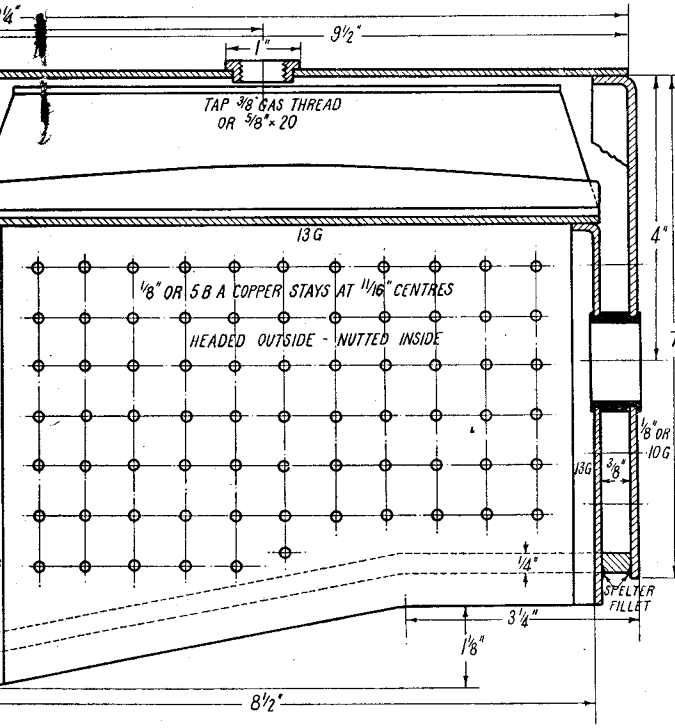
Boiler for the "Minx"

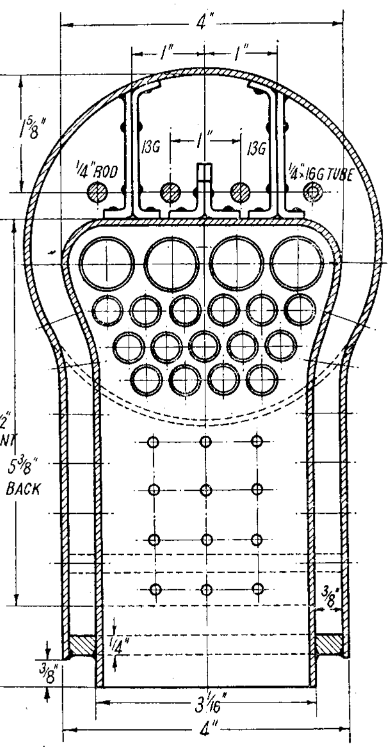
Smokebox Tubeplate

As the smokebox tubeplate is needed to support the ends of the tubes, and act as a spacer, whilst they are being silver-soldered into the firebox, make this next. Cut out a disc of $\frac{1}{8}$-in. or 10-gauge sheet copper $5\frac{3}{4}$ in. diameter, anneal it, and flange it over a circular former $4\frac{5}{8}$ in. diameter. This may be an old wheel, chuck plate, or anything else of the same kind which will stand a "bashing." You'll probably have to anneal the copper two or three times before you get a perfect flange. When O.K., chuck the disc in three-jaw, flange outwards, in the outside jaws, and turn off the ragged edge; then reverse,

and hold the plate by the inside, on the outside of the top step of the outside jaws. You can't use the inside jaws, because the steps nearest centre get in the way. Turn down the flange to a tight fit in the end of the boiler barrel. Tip to beginners : a tool with plenty of top rake, plus a dose of cutting oil (same stuff as used for turning steel ; I use " Cutmax " diluted with ordinary paraffin) makes copper turning a " cake-walk."

Lay the firebox former on the smokebox tube-





plate, centrally and with the No. 40 holes corresponding to the position of the tube holes shown in the illustration of the smokebox tubeplate ; clamp it in position with a toolmaker's cramp, and poke the No. 40 drill through the lot. Remove former, and open out the holes as described for the firebox tubeplate, but countersink them on both sides. The other holes, for stays and steampipe, are drilled and tapped as shown in the drawing. Anoint both drills and taps with the cutting oil, as mentioned above, and you'll get lovely clean threads.

How to Fix the Tubes

Builders who have had previous experience in small locomotives boiler construction, can put the whole of the tubes in at one fell swoop, if they so desire. Beginners and inexperienced workers had better take two " bites." For the " all-or-nothing " effort, smear some wet flux all over the tube holes, and then insert the tubes one by one, giving each a dose of the flux before inserting. By this means you don't get any places uncovered by flux, and the risk of " pinholes " is avoided. Like Mary's little lamb, wherever the flux went, the silver-solder is sure to go. We use silver-solder for the job, because of its free-flowing and penetrating qualities ; but a coarse grade will do, such as Johnson-Matthey's B-6 alloy. You don't need the best grade on a boiler this size, because it should not melt too easily, in case it fancies to melt just when you don't want it, e.g. on the final brazing job. Boron compo. or Tenacity No. 1 are the fluxes I use, mixed to a creamy paste with water.

Put the smokebox tubeplate on the outer ends of the tubes ; this is a job where patience is a virtue, like putting clockworks together, but a wooden skewer or a blacklead pencil is a wonderful aid ! Line up the nest of tubes parallel with the firebox, then stand the whole lot in the brazing pan with the tubes pointing skyward. Pile coke or breeze all around, and inside the box, to within ½ in. or so of the tubeplate. Cut some little bits of silver-solder about ⅛ in. to 3/16 in. square, and drop them among the tubes. Now carefully heat up the whole issue, but don't play the blowlamp flame direct on the tubes, until the tubeplate itself is glowing, and the coke inside the box is red-hot. At this stage, play the flame half inside the box and half outside, so that the tubeplate, and about 1 in. of the tubes, attains a medium red at same time. The silver-solder will then melt, flow into the countersinks around each tube, and make a perfect seal. If you see any bits that have not melted and run, prod them with the scratching wire against the nearest

(*Continued on page* 362)

*The George Stephenson Centenary Commemoration

by W. J. Hughes

THE name "Fred Smith, of Pinxton," is also well known to MODEL ENGINEER readers (though we haven't seen it as often as we might, of late!). Two of his models were on the stand of Markham & Co. Ltd., and are shown in photographs Nos 7 and 8, a steam winder and an electric winder respectively. Both models are to 1-in. scale; the prototype of the steam winding engine was erected at Portland No. 1 Pit, Kirkby-in-Ashfield, in 1821, and was dismantled in 1916.

motive of the M.S. & L. Railway was slightly over 7 in. gauge, and from the fittings it appears to be a working model. (Note the size of feed and clack-valve.) Another locomotive model loaned by British Railways (Western Region) was one with glass boiler and tubes, but it was largely obscured by a notice "OUT OF ORDER." A beautifully-built model of the light cruiser, H.M.S. *Ceres*, had been loaned by Thos. Firth & John Brown Ltd.; it was about 10 ft. long—

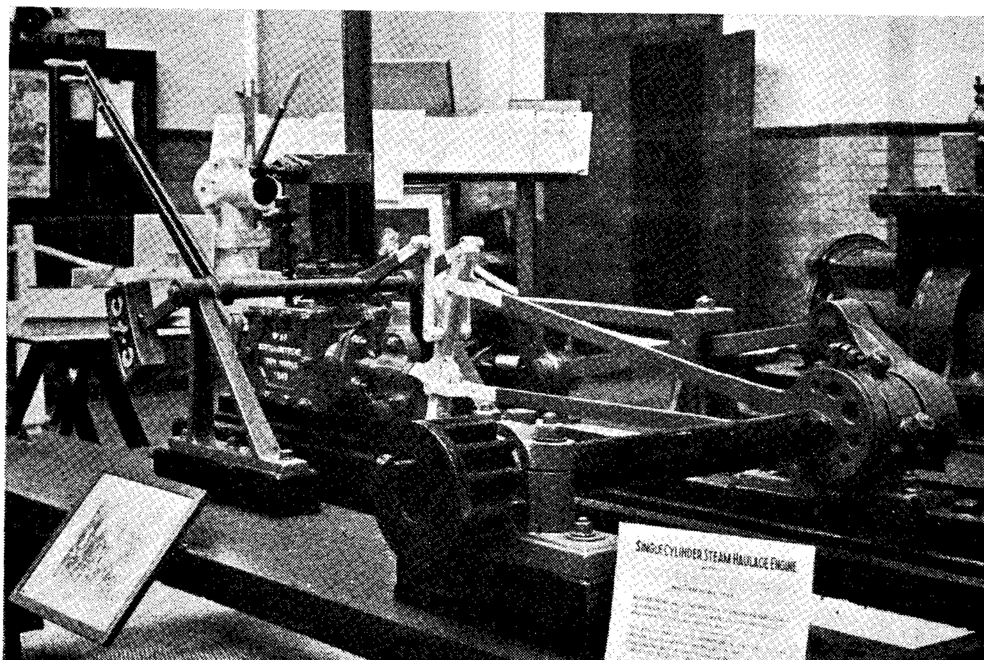


Photo by] [*Press Photo Agency, Sheffield*

Photo No. 6.—The engine with the original link-motion. Another century-old hard-worker!

Also on this stand was a professionally-built model of a skip-winding equipment, complete with engine-room, pit-head gear, shaft, etc.; and a very intriguing large photograph of "Old Faithful," a hauling-engine designed by Robert Stephenson and used on the Leicester & Swannington (later L.M.S.) Railway from 1833 to 1947. I hope to give fuller details of this engine, too, later on.

The stand of the Chesterfield Tube Co. Ltd. had a large number of models, of which photograph No. 9 shows one example. This loco-

probably ¼-in. scale, since the length of the prototype was 450 ft. Displacement was 4,290 tons and speed 29 knots, with eight 5-in. guns and eight 21-in. torpedo tubes. Another most interesting model by the same firm was that of a steel-making plant.

Vickers-Armstrongs had lent a model of their Walker Naval Yard, and the B.T.H. Co. a beautiful model, $\frac{3}{16}$ in. to 1 ft., of part of the new Staythorpe Power Station, comprising three boilers and one turbo-alternator.

Unfortunately, all these models were in large glass cases, and the nature of the reflections was such as to make photography impossible.

The Chesterfield and District Technical College

**Continued from page* 318, "*M.E.*," *September* 23, 1948.

had a very good show, divided into mechanical, electrical and what might be termed historical engineering.

The first section included many examples of modern industrial measurement, while the second traced the historical development of electrical discharges in gases and in vacuum. In the third section was a model of the Stephenson link-motion, dated 1842. It was lent by the family of the inventor, William Howe, and it seems likely that it was made by him. Another exhibit was a drawing of "Shifting - Link Motion as originally designed by William Howe and first applied by Messrs. Robt. Stephenson & Co. on their Locomotives in 1842." The College also exhibited a laboratory vacuum pump which once belonged to George Stephenson, and which is still in use; and a pictorial display of improvements in transport during the 19th and 20th centuries was another feature.

The Railway Exhibition

Leaving the Engineering Exhibition, a few minutes'

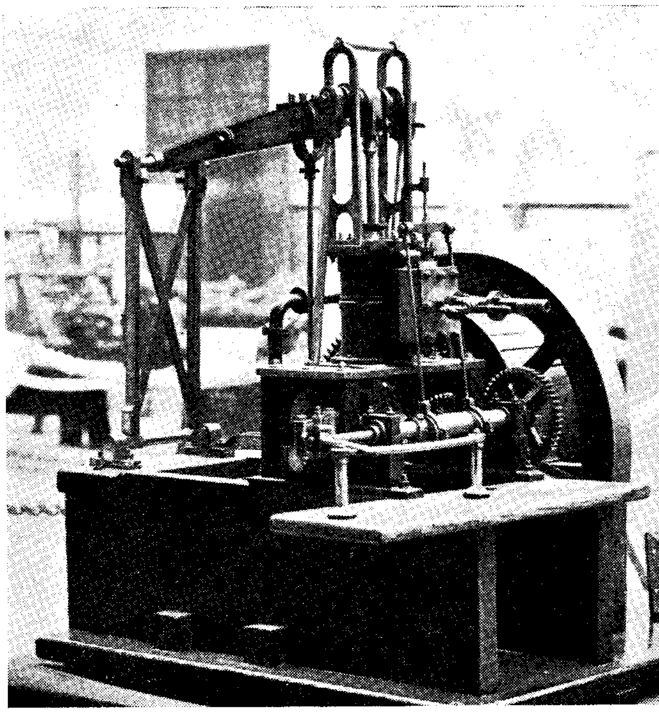


Photo by] [*Press Photo Agency, Sheffield*
Photo No. 7.—Steam winding-engine of Grasshopper type, built to 1-in. scale by F. Smith (Pinxton)

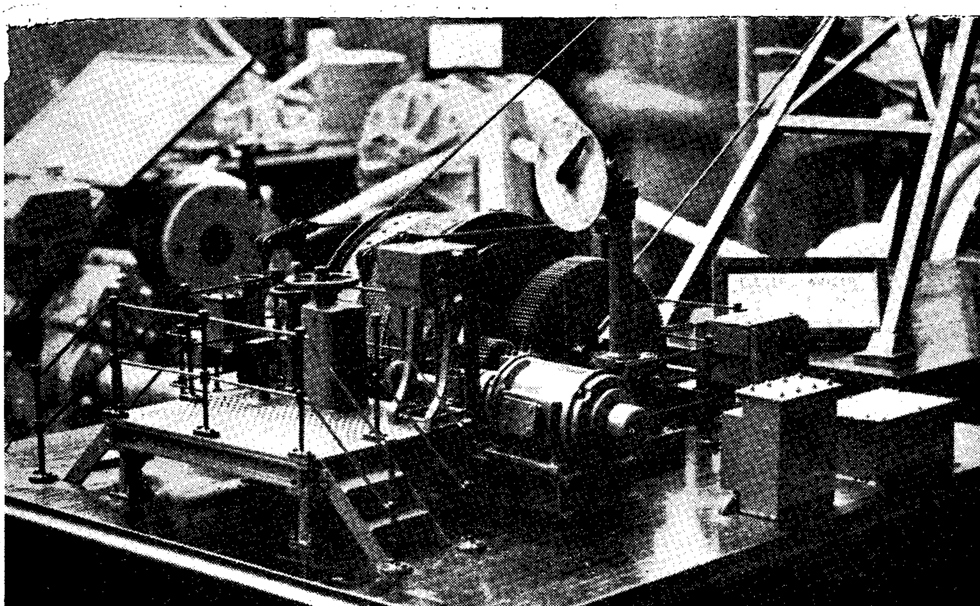


Photo by] [*Press Photo Agency, Sheffield*
Photo No. 8.—In constrast, an electric winding-engine, also to 1-in. scale, by F. Smith. This model was shown at work from time to time

walk brought one to Market Place Station, where a long queue testified to the popularity of the Railway Exhibition.

Inside the barrier, on the left was a full-size facsimile of the cab and backhead of a Pacific, and on the right a train composing the first part of the Exhibition. The first vehicle was Queen Victoria's saloon, originally built as two six-wheelers, but later joined into one bogie-type vehicle. Queen Adelaide's saloon coach was a four-wheeler built in 1842, making one realise the improvement in comfort of today's coaches! In two parcels bogie-vans were numerous small exhibits, mostly of documentary or pictorial interest, but including several fine model locomotives, including a "Royal Scot," "Coronation" (former L.N.W.R.), "Silver Link," "Flying Scotsman" (No. 4472), and an N.E. Atlantic.

Two further vans carried signalling equipment, and then came examples of modern rolling stock, passenger and goods.

However, I was more interested in the locomotives, on two adjacent tracks. First came the full-size replica of the *Rocket*, followed by *Lion*, which I saw at Crewe last year. She was built for the Liverpool & Manchester Railway in 1838, by Tod, Kitson & Laird. After 21 years on the railway and 70 years as a stationary (pumping) engine, she was later restored to her original condition. Her custodian at Crewe told me she had been out "film-making," and could still do her 30 m.p.h. With boiler-pressure of 50 lb. per sq. in., cylinders 12 in. by 18 in., and 5-ft. driving-wheels, her tractive effort was 1,840 tons.

The old M.R. locomotive No. 118 was built at Derby in 1897, and rebuilt in 1928 after covering more than 774,000 miles. These grand engines were known as the "Midland Spinners," and with their equally lovely companions the "Crimson Ramblers," made one's boyhood journeys equally as interesting as today's—even though in those days few people had thought of "taking numbers"! But I digress!

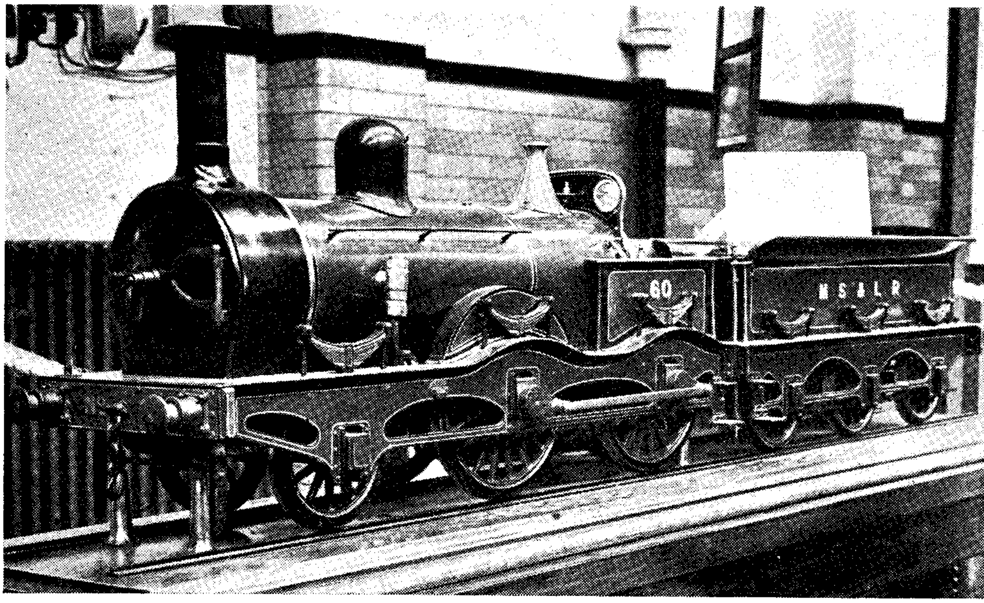


Photo by] [*Press Photo Agency, Sheffield*

Photo No. 9.—A well-finished model M.S. and L. locomotive, loaned by British Railways (Eastern Region)

Another M.R. old-timer was the double-framed Kirtley of 1866. She was at work up to August, 1947, and ran 1,660,000 miles in that period. Next in the line was "Prince George," one of the G.C.R. "Directors," built in 1913, and then a converted "Patriot" specially named *Stephenson* in honour of the Centenary—"the fourth of a long line of locomotives descended from the *Rocket* to bear this distinguished name"—to quote the official programme. Last, but not least, was the B.1 No. 1085—a number which must have been written down hundreds of times during the period of the exhibition! All the locomotives mentioned in this paragraph had steps up to the footplate, and a long crocodile of people was passing endlessly through the cabs.

Exhibition of Relics and Documents

At the Stephenson Memorial Hall alone one could have spent a whole day, scanning the pictorial and documentary exhibits, but, of course, there would not be much point in describing

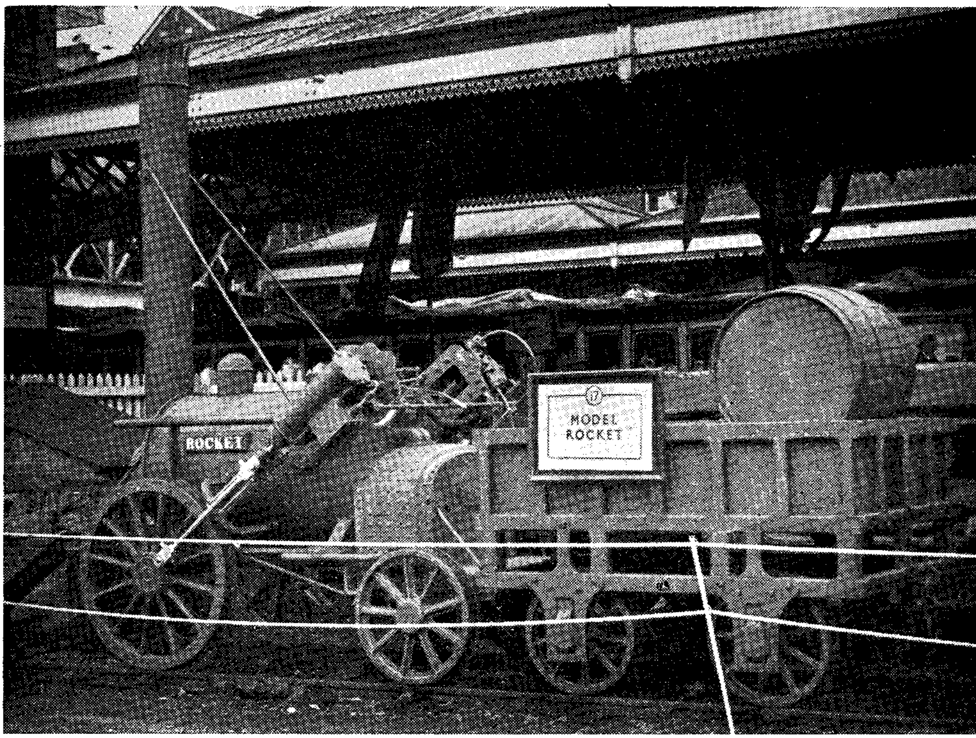


Photo by] [*Press Photo Agency, Sheffield*
Photo No. 10.—*Full-sized model of "The Rocket" in the Railway Exhibition*

Photo by] [*Press Photo Agency, Sheffield*
Photo No. 11.—"*Lion," built* 110 *years ago, can still do her* 30 *m.p.h. under her own steam*!

most of them. However, the first thing to catch a model engineer's eye was a beautiful part-sectioned model of the *Rocket*. Loaned by the Science Museum, it was built by Stuart Turners, who are to be congratulated on the finish and general appearance. From it I learned two new (to me) facts—one, that the firebox had no water space at back or front, and two, that the pressure gauge was in the form of a column of mercury in a tube attached to the side of the chimney! The wheel-flanges of the model rested on rollers, and when a handle was turned the action of the valve-gear could be watched.

Another exhibit from the Science Museum was a drawing of the Killingworth locomotive, dated 1815, supposed to have been made by Stephenson himself: also, in another case, were several of his personal possessions, including measuring instruments and watches.

The Mining Exhibition

Probably to describe the chief feature of the Mining Exhibition one can do no better than to paraphrase the Official Brochure—with due acknowledgment.

"The main feature . . . is a realistic representation of a coal mine in the Drill Hall itself. In this mine, visitors are taken in the cage to the bottom of the shaft. The layout of the workings is explained and they pass along the roads to an airlock, from where they continue to the loader-end. Here the coal from a conveyor belt is being loaded into tubs. The conveyor leads to the coal-face, where the process of cutting, drilling and firing is explained by an experienced miner. After a visit to the face, the road leads back to another airlock, and thence to the bottom of the upcast shaft for the ride back to the surface."

Also in the exhibition were a collection of safety lamps, showing their evolution from Stephenson's day, and examples of tools and machines, including the modern Joy loader and A.B. Meco-Moore cutter-loader, two most ingenious machines.

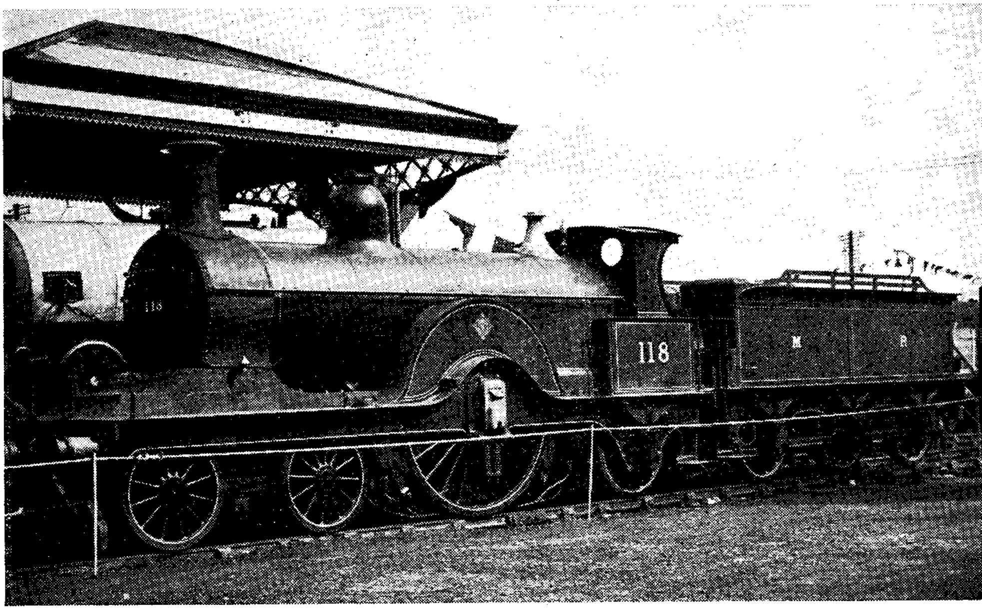


Photo by] [*Press Photo Agency, Sheffield*

Photo No. 12.—*One of the "Midland Spinners"—lovely relic of bygone days in her crimson coat*

The End of a Perfect Day

As the reader can well imagine, after the day's exertions it would have been agreeable to visit the official film show, if only for a rest. However, time and omnibuses wait for no man, and with the melodious jangle of bells from Chesterfield's Crooked Spire in my ears I reluctantly wended my way to the bus station. I said earlier that the organisation of the commemoration was worthy of the occasion, and on behalf of all visitors I must thank Chesterfield for a grand effort!

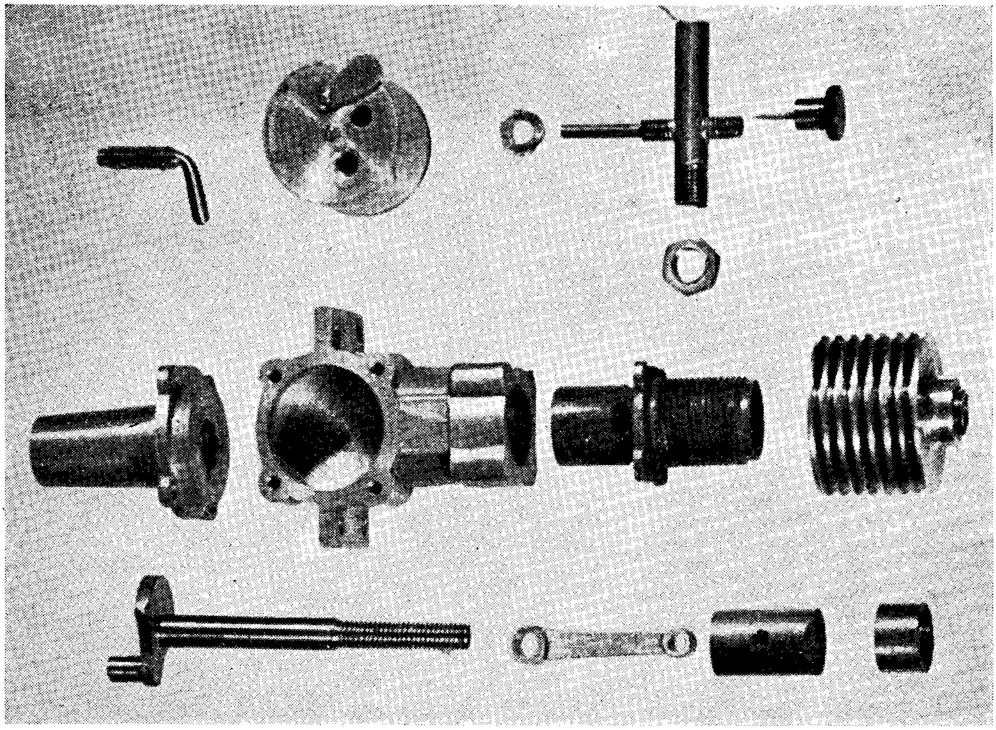
By the by, a fund is being raised for a George Stephenson Memorial, so that the grave may be made worthy of such a great man. Any surplus will probably be used for the foundation of George Stephenson Engineering Scholarships. I feel sure that the Mayor would be happy to receive (at the Town Hall, Chesterfield) any sum you may care to send. Thanks a lot!

[These celebrations at Chesterfield were certainly worthy of the memory of one of the world's great men. George Stephenson must ever be regarded as one of mankind's greatest benefactors; his courage, ingenuity and foresight, in the face of severe opposition and disappointment from many quarters, were exemplary, and he did not fail us.—ED., "M.E."]

*A 1.5 c.c. Compression-ignition Engine

by "Battiwallah"

THE final lapping to size can now proceed. With the piston pinned on the holder, chuck the latter as accurately as possible and run the job at top lathe speed. As with internal lapping, do not swamp the lap with abrasive paste; clean the lap frequently and renew the abrasive. Cutting will proceed all the faster for so doing. Micrometer the diameter at various points along the length of the work to see that it is parallel; if it is not, the large part can usually be detected by the feel of the lap and the high spot should be concentrated on until it is eliminated. When the diameter is within one thou. of the cylinder bore diameter, thoroughly clean off every vestige of abrasive on the surface of the piston and try it in the cylinder but before you try to enter it, apply a trace of clean tallow. The work should just not enter the bore at this stage. If it does, but tightly so, all well and good, but go very cautiously now. Make the test at each end of the bore to check the latter again for parallelism. If the piston goes in very easily—well, speaking in the vernacular: "You've had it." A fresh start must be made. Let us hope that care and attention will have avoided this step. The final steps are slow; use an almost dry lap, clean the job and the bore for each trial, and, above all, do not try to hurry the fitting operation. Time spent on this is time well spent. When getting very near the final stages, allow the piston to cool right down if the lapping has heated it. The final fit is such that the piston can be pushed right through the cylinder but, not easily so, without the slightest hint of slack anywhere. A test is to enter the piston in the cylinder for about $\frac{1}{4}$ in., and hold the cylinder against a strong light so that one looks through the bore. Not the slightest sign of daylight should be visible when the fitted surfaces are free from oil or grease. In the early stages of fitting, if there is any taper in the cylinder bore it will be detected, and it may be possible to correct this, if it is but slight, by additional local lapping. It is not a bad plan to lap up a gauge for the bore to verify that it is parallel. The head of a $\frac{1}{4}$-in. bolt turned down and lapped does the trick.



Components of the 1.5-c.c. compression-ignition engine

Be very careful in removing the piston from

*Continued from page 307, "M.E.," September 16, 1948.

the holder. Slip a piece of $\frac{3}{8}$-in. copper or brass tubing over the holder and tap the piston off with this.

The Compression-adjusting piston

Turn this up on the end of a piece of $\frac{1}{2}$-in. round mild-steel, recessing the end with a boring tool: reduce the diameter of the stock for about $\frac{1}{2}$ in. to give clearance for the lap and then lap to size. This piston must be a tap fit in the top of the cylinder bore. The difference in diameter compared with the working piston will hardly be discernible by measurement, unless you have a good micrometer, but the difference must be there. Part it off when it is finally fitted. If this part is a loose fit it is no use.

Preliminary Assembly

A number of finished, or nearly finished, parts have now been accumulated and the constructor is itching to fit them together to see what the job is going to look like. Very well, here goes then. But first, the crankshaft and the main bearing have to be lapped to fit, for we put these parts aside.

The internal lap for the bush can consist of a piece of $\frac{1}{16}$-in. softened copper-sheet wrapped round $\frac{3}{16}$-in. steel rod tapered off to say 5/32 in. in about 3 in. Make the lapping surface $1\frac{1}{2}$ in. long. With all that has previously been said on the subject of lapping, the constructor should now have no difficulty in finishing the fitting of the shaft to its bearing. There must be no wobble.

A gudgeon-pin has to be fitted carefully to the piston; this is shown at the bottom of Fig. 14. Do not force it in or you will distort the piston; neither must it fit loosely. If the drill used was accurate and a piece of 0.125-in. silver-steel is used there should be no difficulty in getting the right fit.

Be scrupulously clean in assembling the parts. A good plan is to wash them thoroughly in paraffin, finishing with clean paraffin, and then scour the parts under running water. This treatment removes all the abrasive left on after the lapping operations.

After assembling the parts so far made, you will be able to check up on the port openings, if the cylinder is secured with four temporary 6-B.A. screws. If the measurements have been adhered to, all should be well; the top of the piston should be level with the bottom of the exhaust openings in the cylinder when the crank is at dead bottom centre, and the bottom of the piston should be at the top of the inlet port when the crank is at dead top centre. The transfer should open just a little after the exhaust opens, but it will be difficult to see this. Lubricate the piston with clean tallow for turning the engine over; if the fit is a trifle on the tight side—a good fault—ordinary lubricating oil tends to cause binding. At this stage, the engine can be given a slow running-in by simply driving it in the lathe, putting a piece of soft brass between the crankshaft and the chuck jaws, and holding the engine in the hand. Then, if it tends to run too tight, one can easily tell by the feel. Lubricate freely with clean motor-car engine oil while running-in. Do not attempt to force this running-in process, however; if the engine is too stiff, find out where the trouble lies and rectify it. When the engine is working freely the compression should be quite strongly felt with the compression-piston flush with the cylinder top, and compression should be retained with the piston at top centre for a minute or more. Leakage can be detected by bubbling of the lubricant at the exhaust or inlet port openings, or at the cylinder top if the compression-adjusting piston is at fault. Let us hope no bubbling occurs. If this happy state of affairs is reached, then the trying part of the work can be regarded as over and the rest is fairly simple, for there is no exacting fitting task remaining.

The Cooling Fins

If you can lay your hands on a nice piece of 1-in. diameter drawn aluminium bar, so much the better. If not, the "foundry" can be started up and a short length of $1\frac{1}{8}$-in. diameter can be cast in a mould of wrapped sheet-metal similar to the headers which were made for the dies.

The details are shown in Fig. 15. The holes for the fixing studs should be drilled before the fins are turned, or else the drill will wander all over the place, for the fins cut well into these holes. In drilling the holes, use the template Fig. 6 for marking off, *and the right side up too.* A small steel bush is screwed into the top of the cooling fins to take the compression-adjusting screw; these two parts are shown at the right of Fig. 15. This screw has to withstand a heavy thrust and, if the aluminium is merely tapped 4-B.A. to receive it, the chances are that in time the thread will strip. The fins are a simple parting-tool job. The bore should neatly fit the cylinder.

Four 7/64-in. diameter studs are required, screwed 6-B.A. at each end to secure the crankcase casting, the cylinder, and the cooling fins.

The Carburettor

The complete affair is shown in Fig. 16. If a separate fuel tank is preferred, this item can be omitted from the construction; otherwise, the remainder is the same. A length of 3/32-in. diameter oil- and petrol-resisting tube can be used for connecting the jet extension to the tank. The latter should be disposed so that the fuel level is always below the jet orifice level.

Drill a 5/32-in. hole radially through a piece of $\frac{1}{4}$ in. diameter mild-steel rod, a good $\frac{5}{8}$ in. from the end and then drill the rod axially to a depth of $1\frac{5}{8}$ in., at $\frac{1}{8}$ in. diameter. Push a $\frac{3}{4}$-in. length of 5/32-in. diameter steel rod through the radial hole in the $\frac{1}{4}$ in. round piece, leaving a good $\frac{1}{4}$ in. projecting on one side, and braze.

Make a taper D-bit in $\frac{3}{16}$-in. round silver-steel tapering from the full diameter to $\frac{1}{8}$ in. in $\frac{5}{8}$ in. Trim one end of the $\frac{1}{4}$-in. diameter member of the cross-piece to $\frac{5}{8}$ in. from the centre of the 5/32-in. piece and ream out the taper with the D-bit just made. Trim the other end of the $\frac{1}{4}$-in. diameter member to $\frac{7}{8}$ in. from the centre and taking care not to damage the end already tapered when gripping it in the lathe chuck, open out the other end to $\frac{3}{16}$ in. diameter for $\frac{1}{4}$ in. depth, and taper the remainder. Thread this same end for $\frac{1}{4}$ in. at 32 t.p.i. Holding the

longer end of the 5/32-in. diameter piece in the lathe chuck to run truly, drill right through at No. 45 on the $\frac{1}{4}$ in. long end. Cut the other end to about $\frac{1}{8}$ in. long and open out this end to 3/32 in. bore. Tap the other side 7-B.A. Clean the part and tin it all over ; there is a soldering

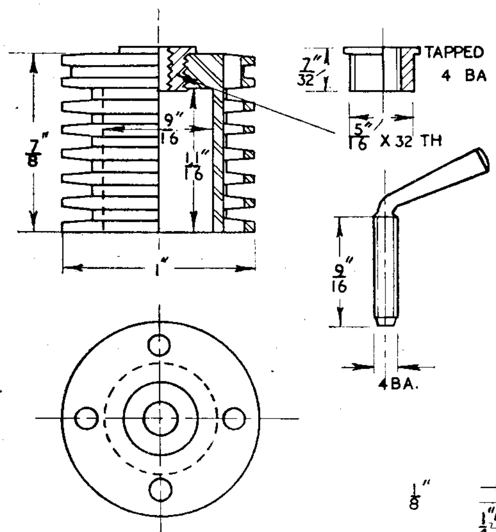


Fig. 15. Cooling fins and compression-adjusting screw

job to be done and a tinned job looks better, provided the surplus tin is wiped off, and the part is made rust-proof too.

The jet is a piece of 3/32-in. diameter brass, $\frac{1}{2}$ in. long, drilled for $\frac{1}{8}$ in. depth at No. 70, and the remainder of the length drilled at No. 52 or $\frac{1}{16}$ in. diameter. A short piece of petrol- and oil-proof 3/32-in. diameter tubing is slipped on to the lower end of the jet to reach to the bottom of the fuel tank. This is better than trying to make the jet and the feeding tube in one piece, for one so often comes to grief in drilling small holes deeply. The jet is secured in position by soldering. When doing this, don't swamp it with flux and solder, or the fine hole may be filled with solder. It is important to arrange that the jet projects just into the choke tube when it is soldered and that the excess is cleaned off with a round file to make the jet orifice flush with the tube. If the jet is otherwise, good atomisation of the fuel may not occur.

If the integral fuel tank is decided upon, turn up the top from $\frac{1}{16}$-in. thick brass sheet ; note the underside is machined away for lightness. Drill it for the filling hole, the bolt securing the tank parts together, and $\frac{1}{4}$ in. where it fits on the cross-piece. The latter and the tank top can then be soldered together and, for sake of appearance tin the tank top also. The cover for the filling hole can be thin aluminium and an ordinary pin will serve as a rivet.

The rest of the fuel tank is a simple job in aluminium tube and and a turned disc from $\frac{1}{16}$-in. thick aluminium sheet.

If you can form celluloid, Perspex, or others of the thermosetting plastics, you may be tempted to make a fuel tank in one of these materials. Properly made, they look quite smart ; they also have the advantages of lightness and for certain materials, transparency, so that the contents of the tank can be seen.

Make the jet adjusting screw of steel and see that the point is true. A small spring should be used at the top to prevent it turning when the engine is running.

Final Assembly

If the preliminary assembling has been done, dismantle all the parts except the piston and connecting-rod, and thoroughly clean them again in paraffin and swill in running water, drying them afterwards, of course. Having gone to this trouble, don't proceed with assembling the

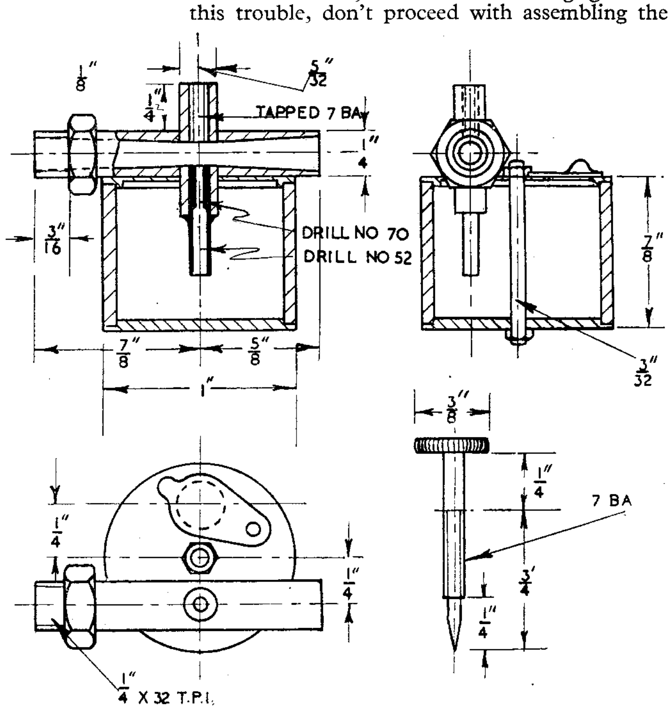


Fig. 16. Carburettor ; the fuel tank can be omitted if a separate fuel tank is desired

parts with dirty, gritty hands ; have them clean too. It may seem trifling to make such a fetish of cleanliness, but it is well worth while, for minute quantities of grit retained in the engine will do much to shorten its life.

A little clean, thick motor-engine oil should be smeared on each of the working surfaces as assembly proceeds. The various joints are

rendered gas-tight by the application of oil-resisting jointing compound such as is used for motor-car engines. It is advisable to insert a thin paper joint between the cylinder flange and the crankcase casting, and also to treat this with jointing compound, to ensure a perfect seal at the top of the transfer port.

The carburettor can be used either way up, according to whichever way up it is desired to run the engine. But those who are not yet accustomed to engines of this sort are advised not to try it first in the inverted position because if excessive fuel does enter the crankcase during the initial attempts to start the engine, damage might occur. This risk is not great, but it is there.

Starting the Engine

We must have some load for the engine and the easiest and best is an air-screw, for it will help to cool the new engine should it be inclined to run hot because of its newness. An air-screw of 9 or 10 in. diameter will do nicely.

Firmly screw the engine to a block of hardwood suitably recessed for the crankcase.

A very good fuel for starting a new engine is 60 per cent. non-anaesthetic ether and 40 per cent. Redex. Fill the fuel tank with this.

While we are on the subject of fuel, it is rather important to clean out the engine thoroughly after a run by syringing the cylinder with clean paraffin, through the exhaust ports and the crankcase, *via* the inlet port. This is because many of the varieties of commercial ether obtainable are acid and when an engine is left uncleaned after a run, the remnant ether evaporates and leaves an acid residue on the cylinder wall, and when the engine is turned over several days later, a mysterious loss of compression is discovered. The reason for this is that scores have been eroded in the cylinder bore and on the piston; the only cure for this is to renew the piston—and the compression adjusting piston, of course, after lapping the scores out of the cylinder.

Open the jet screw about one turn and while the engine is given two or three turns, hold a finger over the carburettor intake to choke it. If fuel is on the finger there is proof that it is being sucked into the crankcase. If not, open up the jet a little at a time until there is evidence that fuel is being taken in. Be careful not to overdo the priming. Decrease the compression space until the compression can be strongly felt and give the airscrew a sharp flick round. If you are lucky, the engine may fire; the chances are that you will not hit upon the correct settings of compression and fuel at the first trial; repeated trials will enable one to find these settings. Proceed methodically, and eventually the engine will give signs of life. When this point is reached, don't be too anxious to make further adjustments hurriedly and make each subsequent adjustment slight, for these engines are quite critical to fuel and compression settings. There is usually need for a fair degree of patience when first starting a new engine. Once the settings are found, however, they can be noted and it is not difficult to start the engine afterwards. It will generally be found that the compression can be eased off when the engine has started, and it is advisable to release it as far as possible, consistent with even firing and not too sharp an exhaust note, for when this occurs, the engine will run too hot. A weak mixture also has this effect so before increasing the compression, try opening the fuel jet a little more.

If the engine runs for a few seconds and stops, the cause is most probably too much compression. If it hunts, the cause is insufficient fuel. After a few trials, the tricks and moods of the engine will become familiar and starting and steady running will be easily obtained.

Never forget that you have expended a considerable amount of time and patience in obtaining the essentially good fit of the piston in the cylinder; it is, therefore, worth your while to preserve this fit by keeping the engine scrupulously clean. Do not run it unnecessarily, especially at high speeds with little or no load, for like most high-speed engines, its high-efficiency life is not indefinite. Treated kindly and used carefully, the little engine will give good service for quite a long time, certainly well enough to warrant the time expended in its construction.

"L.B.S.C." (*Continued from page* 353)

tube, also apply it to any place that bubbles. A little extra silver-solder can be applied to the outer row of tubes for luck. Give the whole lot a final blow-up for a few seconds, just to make sure that the metal is running freely; then let cool to black, quench out in pickle, leaving the job in for about 20 minutes, and finally wash off.

Instead of dropping bits of silver-solder among the tubes, a Watford friend, Mr. T. Hearn, uses silver-solder in wire form, fits a ring of it around each tube, and presses the rings down on the tubeplate. When heated, they just melt and run in the joints; this is an excellent wheeze.

Beginners should put in the flues and top row of tubes first, and silver-solder these as described above, except that instead of cutting up the silver-solder, the strip is applied to each tube separately. If the metal is at the correct heat, the silver-solder will melt and "flash" like water, clean around the tube. Pickle and wash off as above, then clean up the remaining tube holes, smear more wet flux on, insert the rest of the tubes, and repeat the operation. The silver-solder can be applied to the second row, by poking the strip between the tubes in the bottom row. When it has run all around them, pickle and wash off once more.

When all the tubes have been fixed satisfactorily—they should be O.K. if you can see a silvery ring extending completely around every one, on the inside of the firebox—remove the smokebox tubeplate, heat all the ends of the tubes to medium red, and quench them out in the pickle. Beware of splashes! This softens them all ready for expanding into the smokebox tubeplate when the boiler is being assembled.

Editor's Correspondence

Worm for a Superfine Feed Attachment

DEAR SIR,—I have just returned from leave and seen your issue of July 29th, and was very interested in "Ned's" superfine feed attachment. My own idea on these lines was to drive the worm by bevel gears from the mandrel, which obviates the separate belt drive. However, this letter is about the worm.

As "Ned" says, a worm of six threads per inch, though not accurate, can be used. I suggest however, that a more accurate worm be cut, because when not required for the feed the same one can be used for indexing (by meshing with a change-wheel attached at the back of the mandrel).

The lead of the worm must be equal to the circular pitch of the change-wheel: for a diametral pitch of 20, this is $20/\pi$. As π is an irrational number, an approximate must be found. The commonest is $\pi = 22/7$: taking this value, gears can readily be calculated to cut the correct thread, e.g. (for lead screw of 8 t.p.i.) drivers 40, 55; driven 50, 35. The error is 1 in 2,483, which is small enough for most purposes but not for specially accurate indexing of large numbers of divisions.

The next nearest approximation is 3.142 (error 1 in 7,700) but the prime factors of 3,142 are 2 and 1,571 which are not convenient for gearing. However, the next approximation is 3.1416, and 31,416 readily factorises. The gears required in this case will be (for lead screw of 8 t.p.i.) drivers 21, 22, 34; driven 20, 25, 25 (or, of course, multiples calculated in the usual way, e.g. drivers 84, 44, 68; driven 80, 50, 50). The error is only 1 in 392,699.

Yours faithfully,
Penshurst. ALFRED H. JANES.
Major, B.Sc., F.R.A.S.

Exhibition Paint-work

DEAR SIR,—It was only possible for me to spend a couple of hours at THE MODEL ENGINEER Exhibition this year, but once again I was struck by the beautiful finish obtained by many exhibitors in the painting of their models, especially in the locomotive section. There were also, alas, some exhibits on which the painting was awful, and for these I had great sympathy, as being comparable with my own efforts in that direction.

It is very sad to spend months or even years making a model and achieving a comparatively high standard of finish in the actual manufacture, only to ruin it completely when one starts to operate with the paint-brush. It would, therefore, fulfil a long-felt want so far as I am concerned, and also of hundreds like me, I have no doubt, if one or more of the exhibitors of those beautifully painted and lined models would be generously hearted enough to tell us how they do it, through the medium of your columns.

Yours faithfully,
Hildenborough. R. H. PROCTER.

For the Bookshelf

The Railways of Britain, by O. S. Nock (London: B. T. Batsford Ltd.) 120 pages, size $5\frac{1}{4}$ in. by $8\frac{1}{2}$ in. Four coloured plates and many other illustrations. Price 15s. net.

Railway literature has flowed very freely from the printing presses in recent years; some of it is scarcely of lasting value, but when it is from an author who is at once an enthusiast, a technical expert, a close observer, a facile writer and one more than usually well-versed in railway operation, it assumes a quality which places it in the forefront of worthwhile literary work.

Of such a nature is this book. Written in an easy-flowing, entertaining style, Mr. Nock's account is not ponderously progressive; yet it is well-knit and coherent; most of it is fresh and new, in spite of the fact that, to the expert, the subject-matter is mostly familiar. But Mr. Nock writes chiefly of his own personal observations and researches, and he has put together a narrative of which the value is already high, and must be enhanced by the passage of time.

The illustrations, many of them unfamiliar, have been gathered from a number of different sources; they are beautifully reproduced and greatly add to the value and interest of the book. The comic and serious, grave and gay are to be found abundantly scattered through these pages, and we cordially commend the book to the notice, not only of railway enthusiasts, but of a much wider circle of readers.

Plastics in Handicraft. By P. W. Blandford. (London: Chapman and Hall Ltd., 37, Essex Street, W.C.2.) Price 15s.

The very wide variety of new materials now available under the broad term "plastics" has opened up many novel and fascinating possibilities to the craftsman, and the author of this book, who has had much experience as a handicrafts teacher, has exploited these to good effect. After discussing the different kinds of plastics and their various properties, the manipulation of the materials is dealt with, including cutting, drilling, turning, bending, cementing, fabricating, also carving, inlaying and other methods of finishing. Examples are then given of simple objects which can be produced by hand tools, and more advanced ventures in the same class; then still more advanced work which entails machining processes, and the combination of plastics with other materials. The book is profusely illustrated with line drawings and photographs; it can be recommended as a valuable addition to the literature of practical craftsmanship.